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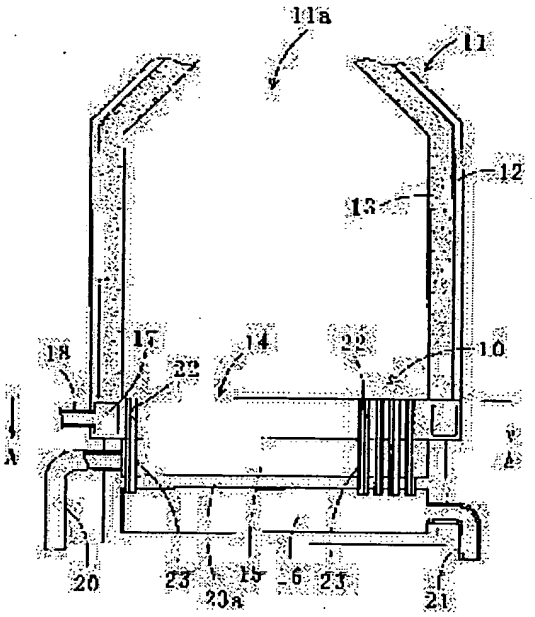
(54) BURNER FOR MANUFACTURING FULLERENE AND METHOD FOR MANUFACTURING FULLERENE USING IT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a burner for manufacturing fullerenes, and a method for manufacturing the fullerenes using the burner, capable of stably manufacturing the fullerenes in a combustion furnace without provoking backfire even when the blow-out velocity of a carbon containing fuel gas and an oxygen containing gas are reduced.

SOLUTION: The burner 10 for manufacturing the fullerenes conducts the carbon containing fuel gas and the oxygen containing gas from a burner head 14 exposed in a reactor 11a into the reactor 11a. On the burner head 14 are set up, mixed and close to each other, many blow-out nozzles P25 through which either the carbon containing fuel gas or the oxygen containing gas is fed and many blow-out nozzles Q24 through which either the carbon containing fuel gas or the oxygen containing gas is fed, while the blow-out nozzles P25 and the blow-out nozzles Q24 have independent gas flow channels to prevent the mixing of the carbon containing fuel gas and the oxygen containing gas in the burner head 14.



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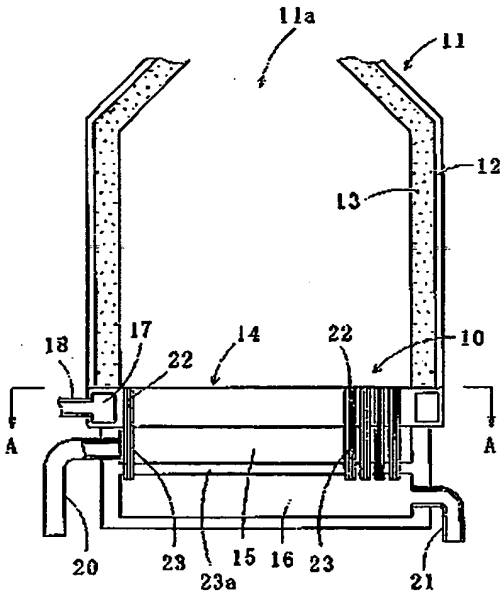
(54)【発明の名称】　フラーレン類の製造用バーナー及びこれを用いたフラーレン類の製造方法

(57)【要約】
【課題】　炭素含有燃料ガス及び酸素含有ガスの噴き出し速度を下げても逆火が起こらず、燃焼炉において安定してフラーレン類を製造可能なフラーレン類の製造用バーナー及びこれを用いたフラーレン類の製造方法を提供する。
【解決手段】　反応炉１１ａに露出するバーナーヘッド１４から、反応炉１１ａ内に炭素含有燃料ガスと酸素含有ガスとを導くフラーレン類の製造用バーナー１０であって、バーナーヘッド１４には、炭素含有燃料ガスと酸素含有ガスのいずれか一方を流す噴出口Ｐ２５と、炭素含有燃料ガスと酸素含有ガスのいずれか他方を流す噴出口Ｑ２４とがそれぞれ混在して小間隔で多数設けられ、しかも、噴出口Ｐ２５と噴出口Ｑ２４とは各々独立したガス通路を有し、バーナーヘッド１４内での炭素含有燃料ガスと酸素含有ガスとの混合を防止するフラーレン類の製造用バーナー及びこれを用いたフラーレン類の製造方法。



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【特許請求の範囲】

【請求項１】　反応炉に臨出するバーナーヘッドから、前記反応炉内に炭素含有燃料ガスと酸素含有ガスとを導くフラーレン類の製造用バーナーであって、前記バーナーヘッドには、前記炭素含有燃料ガスと前記酸素含有ガスのいずれか一方を流す噴出口Ｐと、前記炭素含有燃料ガスと前記酸素含有ガスのいずれか他方を流す噴出口Ｑとがそれぞれ混在して小間隔で多数設けられ、しかも、前記噴出口Ｐと前記噴出口Ｑとは各々独立したガス通路を有し、前記バーナーヘッド内での炭素含有燃料ガスと酸素含有ガスとの混合を防止していることを特徴とするフラーレン類の製造用バーナー。

【請求項２】　請求項１記載のフラーレン類の製造用バーナーにおいて、前記反応炉には複数の前記バーナーヘッドが設けられていることを特徴とするフラーレン類の製造用バーナー。

【請求項３】　請求項１又は２記載のフラーレン類の製造用バーナーにおいて、前記バーナーヘッドの上流側に、それぞれ隔離した第１及び第２の蓄圧室を設け、前記第１の蓄圧室に前記噴出口Ｐのガス通路が連通し、前記第２の蓄圧室に前記噴出口Ｑのガス通路が連通していることを特徴とするフラーレン類の製造用バーナー。

【請求項４】　請求項３記載のフラーレン類の製造用バーナーにおいて、前記第１の蓄圧室より前記第２の蓄圧室が上流側に設けられ、該第１の蓄圧室から前記バーナーヘッドを貫通する挿通孔が設けられ、該挿通孔内の断面形状とは異なる断面形状の第１のパイプが該挿通孔を通って前記第２の蓄圧室まで延設され、前記第１のパイプが前記噴出口Ｑのガス通路を形成し、前記挿通孔と前記第１のパイプの隙間が前記噴出口Ｐのガス通路を形成することを特徴とするフラーレン類の製造用バーナー。

【請求項５】　請求項４記載のフラーレン類の製造用バーナーにおいて、前記挿通孔は断面円形であって、前記第１のパイプの断面は、三角～八角のいずれか１の形状となっていることを特徴とするフラーレン類の製造用バーナー。

【請求項６】　請求項４又は５記載のフラーレン類の製造用バーナーにおいて、前記挿通孔は、前記バーナーヘッドに実質的に均等に配置されていることを特徴とするフラーレン類の製造用バーナー。

【請求項７】　請求項３記載のフラーレン類の製造用バーナーにおいて、前記第１の蓄圧室より前記第２の蓄圧室が上流側に設けられ、前記第１の蓄圧室から前記バーナーヘッドを貫通する挿通孔が設けられていると共に、前記バーナーヘッドには前記挿通孔とは別位置に、前記第１の蓄圧室を通って前記第２の蓄圧室から前記バーナーヘッドを貫通する第２のパイプが設けられ、前記挿通孔が前記噴出口Ｐのガス通路を形成し、前記第２のパイプが前記噴出口Ｑのガス通路を形成することを特徴とするフラーレン類の製造用バーナー。

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【請求項８】　請求項７記載のフラーレン類の製造用バーナーにおいて、前記噴出口Ｐと前記噴出口Ｑは、前記バーナーヘッドに実質的に均等に隣り合って配置されていることを特徴とするフラーレン類の製造用バーナー。

【請求項９】　請求項１～８のいずれか１項に記載のフラーレン類の製造用バーナーを用いて、前記反応炉内で前記炭素含有燃料ガスと前記酸素含有ガスとを反応させてフラーレン類を製造するフラーレン類の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、フラーレン類（C_{60}、C_{70}、C_{76}、C_{78}、C_{84}を含む）の製造用バーナー及びこれを用いたフラーレン類の製造方法に関する。

【０００２】

【従来の技術】フラーレンは、ダイヤモンド、黒鉛に次ぐ第三の炭素同素体の総称であり、C_{60}、C_{70}等に代表されるような５員環と６員環のネットワークで閉じた中空殻状の炭素分子である。フラーレンの存在が最終的に確認されたのは比較的最近の１９９０年のことであり、比較的新しい炭素材料であるが、その特殊な分子構造ゆえ特異的な物理的性質を示すことが認められ、例えば以下のような広範囲な分野に渡り、革新的な用途開発が急速に展開されつつある。

（１）超硬材料への応用

フラーレンを前駆体とすることで微細結晶粒子をもつ人工ダイヤモンド等の精製が可能となるため、付加価値のある耐摩耗材料への利用が期待されている。

（２）医薬品への応用

フラーレン薄膜に金属カリウムをドープすると１８Ｋという高い転移温度を持つ超伝導材料を作り出すことができることが発見され、多方面から注目を集めている。

（３）半導体装置への応用

レジストにC_{60}を混ぜることでレジスト構造がより一層強化されることを利用し、次世代半導体製造への応用が期待されている。各種炭素数のフラーレンの中でも、C_{60}及びC_{70}は比較的合成が容易であり、それゆえ今後の需要も爆発的に高まることが予想されている。現在知られているフラーレンの製造方法としては、レーザー蒸着法、抵抗加熱法、アーク放電法、高周波誘導加熱法、燃焼法、ナフタリン熱分解法等があるが、燃焼炉中でヘリウム等の不活性ガスと酸素との酸素含有ガスと、ベンゼン、トルエン等の炭化水素原料とを不完全燃焼させる燃焼法が比較的製造コストが安価である。

【０００３】

【発明が解決しようとする課題】この燃焼法においては、燃焼炉内にそれぞれガス化した炭化水素原料と酸素含有ガスとを導入して減圧下で不完全燃焼させているが、燃焼炉内にそれぞれ別々に炭化水素原料ガスと酸素含有ガスを導入する燃料供給口と酸素含有ガス供給口を設けてこれらを燃焼させると、燃焼炉内の両ガスの混合

が不完全であるので燃焼反応が部分的にばらつき．フラーレン類の収率が低い。そこで、バーナー内で炭化水素原料ガスと酸素含有ガスをプリミックスした後．多数の小孔（ノズル）から燃焼炉内に噴き出すと、両ガスが混ざった状態で燃焼炉内に吹き込まれることが行われ、燃焼炉内の両ガスの混合性が確保され．これによってフラーレン類の収率を向上することが期待できる。ところが．このようなプリミックスタイプのバーナーを使用すると．操業条件によっては逆火が起こる可能性があり、特に．工業規模での大型の製造炉の場合には重大な問題となり、従って．バーナーの設計に当たっては細心の注意を払う必要があるという問題がある。本発明はかかる事情に鑑みてなされたもので、炭素含有燃料ガス及び酸素含有ガスの噴き出し速度を下げても逆火が起こらず、燃焼炉において安定してフラーレン類を製造可能なフラーレン類の製造用バーナー及びこれを用いたフラーレン類の製造方法を提供することを目的とする。

【０００４】

【課題を解決するための手段】前記目的に沿う第１の発明に係るフラーレン類の製造用バーナーは、反応炉に露出するバーナーヘッドから．前記反応炉内に炭素含有燃料ガスと酸素含有ガスとを導くフラーレン類の製造用バーナーであって．前記バーナーヘッドには、前記炭素含有燃料ガスと前記酸素含有ガスのいずれか一方を噴出口Ｐと．前記炭素含有燃料ガスと前記酸素含有ガスのいずれか他方を流す噴出口Ｑとがそれぞれ混在して小間隔で多数設けられ．しかも、前記噴出口Ｐと前記噴出口Ｑとは各々独立したガス通路を有し、前記バーナーヘッド内での炭素含有燃料ガスと酸素含有ガスとの混合を防止している。これによって、噴出口Ｐ及び噴出口Ｑを通過するガスが混合することがないので、これらのガスの速度を遅くしても逆火の心配がない。更には、噴出口Ｐと噴出口Ｑとは小間隔（例えば．０．５～１００ｍｍ）で多数混在しているので、噴出直後に炭素含有燃料ガスと酸素含有ガスが混ざり合う。ここで、酸素含有ガスには酸素ガス（O_2）を主体とする純酸素ガスの他、オゾンガス（O_3）を主体とする場合も含まれ．更には．ヘリウムやアルゴン等の不活性ガスを含む場合や、酸素含有ガスに爆発限界以下の炭素含有燃料ガスを含む場合もある。また、炭素含有燃料ガスに爆発限界以下の酸素ガスやオゾンガスを含む場合もある。更には、炭素含有燃料ガスにヘリウムやアルゴン等の不活性ガスを含む場合もある。

【０００５】第２の発明に係るフラーレン類の製造用バーナーは、第１の発明に係るフラーレン類の製造用バーナーにおいて．前記反応炉には複数の前記バーナーヘッドが設けられている。これによって．バーナーヘッドをそれぞれ含む複数のバーナーの製造．メンテナンスが容易となる。第３の発明に係るフラーレン類の製造用バーナーは、第１．第２の発明に係るフラーレン類の製造用バーナーにおいて、前記バーナーヘッドの上流側に、それぞれ隔離した第１及び第２の蓄圧室を設け、前記第１の蓄圧室に前記噴出口Ｐのガス通路が連通し、前記第２の蓄圧室に前記噴出口Ｑのガス通路が連通している。これによって、それぞれ噴出口Ｐ及び噴出口Ｑから吐出されるガスの流れが均一になる。

【０００６】第４の発明に係るフラーレン類の製造用バーナーは、第３の発明に係るフラーレン類の製造用バーナーにおいて．前記第１の蓄圧室より前記第２の蓄圧室が上流側に設けられ、該第１の蓄圧室から前記バーナーヘッドを貫通する挿通孔が設けられ．該挿通孔内の断面形状とは異なる断面形状の第１のパイプが該挿通孔を通って前記第２の蓄圧室まで延設され．前記第１のパイプが前記噴出口Ｑのガス通路を形成し．前記挿通孔と前記第１のパイプの隙間が前記噴出口Ｐのガス通路を形成している。これによって、バーナーヘッドに形成する挿通孔の数が減少し．より高い密度で噴出口Ｐ及び噴出口Ｑを形成できる。第５の発明に係るフラーレン類の製造用バーナーは、第４の発明に係るフラーレン類の製造用バーナーにおいて．前記挿通孔は断面円形であって．前記第１のパイプの断面は、三角～八角のいずれか１の形状（更に、好ましくは四角形）となっている。これによって．製作が容易となる。第６の発明に係るフラーレン類の製造用バーナーは、第４．第５の発明に係るフラーレン類の製造用バーナーにおいて、前記挿通孔は．前記バーナーヘッドに実質的に均等に配置されている。これによって、ノズルヘッドからより均等にガスを放出することができ、結果として、より炭素含有燃料ガスと酸素含有ガスの混合を行うことができる。

【０００７】第７の発明に係るフラーレン類の製造用バーナーは、第３の発明に係るフラーレン類の製造用バーナーにおいて．前記第１の蓄圧室より前記第２の蓄圧室が上流側に設けられ、前記第１の蓄圧室から前記バーナーヘッドを貫通する挿通孔が設けられていると共に、前記バーナーヘッドには前記挿通孔とは別位置に．前記第１の蓄圧室を通って前記第２の蓄圧室から前記バーナーヘッドを貫通する第２のパイプが設けられ、前記挿通孔が前記噴出口Ｐのガス通路を形成し．前記第２のパイプが前記噴出口Ｑのガス通路を形成している。第８の発明に係るフラーレン類の製造用バーナーは、第７の発明に係るフラーレン類の製造用バーナーにおいて、前記噴出口Ｐと前記噴出口Ｑは、前記バーナーヘッドに実質的に均等に隣り合って配置されている。これによって．噴出口Ｐと噴出口Ｑとを少し離して別位置に配置でき．全体として噴出口Ｐと噴出口Ｑを効率的に散在させてより炭素含有燃料ガスと酸素含有ガスとの混合性を高めることができる。第９の発明に係るフラーレン類の製造方法は．先に説明した第１～第８の発明に係るフラーレン類の製造用バーナーを用いて．前記反応炉内で前記炭素含有燃料ガスと前記酸素含有ガスとを反応させてフラーレ

ン類を製造しているので．より効率良く、目的とするフラーレンの製造が可能となる。なお．P、Qは2つの噴出口を区別するために用いたもので．技術的意味はない。

【０００８】

【発明の実施の形態】続いて、添付した図面を参照しつつ．本発明を具体化した実施の形態につき説明し．本発明の理解に供する。図１は本発明の第１の実施の形態に係るフラーレン類の製造用バーナーを使用する製造装置の断面図、図２（Ａ）は図１における矢視Ａ－Ａ断面図．（Ｂ）は噴出口部分の変形例を示す説明図．図３は本発明の第２の実施の形態に係るフラーレン類の製造用バーナーを用いた製造装置の断面図．図４は図３における矢視Ｂ－Ｂ断面図、図５は本発明の第３の実施の形態に係るフラーレン類の製造用バーナーを用いた製造装置の断面図、図６は同フラーレン類の製造用バーナーの詳細断面図、図７は同平面図．図８は本発明の第４の実施の形態に係るフラーレン類の製造用バーナーの断面図である。

【０００９】図１、図２に示す本発明の第１の実施の形態に係るフラーレン類の製造用バーナー１０及びこれを用いた製造装置１１について説明する。製造装置１１には．下部から供給される炭素含有燃料ガスと酸素含有ガスを．低圧高温下で反応させてフラーレンを製造する反応炉１１ａを備えている。この反応炉１１ａは上部がテーパ状に縮径する円筒状で耐熱性金属からなる炉壁１２を有し、その内側には耐火材１３が貼られている。炉壁１２の下部にフラーレン類の製造用バーナー１０を有し．このフラーレン類の製造用バーナー１０は．反応炉１１ａに露出した円形板状のバーナーヘッド１４と、その下部に設けられた酸素含有ガスの蓄圧室（第１の蓄圧室）１５と、更にその下部に設けられた炭素含有燃料ガスの蓄圧室（第２の蓄圧室）１６とを備えている。バーナーヘッド１４はステンレス又は銅等の耐熱性金属からなって、その直径は２０～３００ｃｍ程度であり．その周囲には冷却ジャケット部１７が設けられている。図２（Ａ）において．１８及び１９は冷却ジャケット部１７に繋がる冷媒の入口及び出口を示す。ここで、冷媒としては水を使用することもできるが、バーナーヘッド１４の温度が下がるので、適当に加温（例えば１５０～３５０℃）した熱媒を、冷媒として使用することもできる（以下の実施の形態においても同様）。これによって、バーナーヘッド１４の温度の過上昇を防ぐと共に．熱効率を向上させる。冷却ジャケット部１７の材質は．金属材料の一例である鉄、ステンレス、鋼材、銅等を用いることができるが．中でも銅．真鍮のように熱伝導性の高い材料を使用するのがバーナーヘッド１４の冷却を図る上で好ましい（以下の実施の形態においても同じ）。蓄圧室１５には．ヘリウム又はアルゴン等の不活性ガスと酸素とを混合した酸素含有ガスの供給口２０が．蓄圧室１６にはベンゼン、トルエン等の高温が気化させた炭素含有燃料ガスの供給口２１が設けられている。この炭素含有燃料ガスにも、適当量のヘリウム又はアルゴン等の不活性ガスが含まれているのが好ましい。この実施の形態及び以下の実施の形態においては．ガス流は下から上に流れるので．下側が上流側となり．上側から下流側となる。

【００１０】第２の蓄圧室１６には．炭素含有燃料ガスの液化を防止するため又は気化を促進するために適当にヒータを配置することは可能であり．更に、第１の蓄圧室１５にも酸素含有ガスを加熱するためにヒータを設けることは自由である（以下の実施の形態においても同じ）。バーナーヘッド１４には図２（Ａ）に示すように．上下方向に貫通する複数の断面円形の挿通孔２２が所定ピッチ（例えば、３～３０ｍｍ）で均等に設けられている。この挿通孔２２の直径は隣り合う挿通孔２２とのピッチにもよるが、２～２０ｍｍ程度となっている。そして、各挿通孔２２には多角パイプ（第１のパイプ）の一例である四角形のパイプ２３がそれぞれ挿入されている。挿通孔２２は蓄圧室１５に連通しているがパイプ２３は蓄圧室１６に連通している。蓄圧室１５と蓄圧室１６の仕切り板２３ａは完全に閉塞され、蓄圧室１５内の酸素含有ガスと蓄圧室１６の炭素含有燃料ガスとが混合しないようになっている。一方、挿通孔２２とパイプ２３との間には．図２（Ａ）の拡大部に示すように、４つ隙間があり．この隙間を通って蓄圧室１５から酸素含有ガスが反応炉１１ａ内に送り込まれ．パイプ２３を通って蓄圧室１６から炭素含有燃料ガスが反応炉１１ａ内に送られる。従って、パイプ２３の先端が炭素含有燃料ガスの噴出口２４となり．挿通孔２２からパイプ２３の部分を除く先端部分が酸素含有ガスの噴出口２５となる。

【００１１】また、以上のように炭素含有燃料ガスと酸素含有ガスとのガス通路を分けているので、逆火の恐れがなく、フラーレン類が製造できる最適の条件に噴出口２４．２５からの速度を設定できる。また、各パイプ２３から炭素含有燃料ガスをその周囲から酸素含有ガスを供給しているので、バーナーヘッド１４の噴出口２４、２５を出たところで両ガスは混合する。この製造装置１１には、反応炉１１ａからガスと共に排出される生成物を回収するために、バッグフィルターがガス冷却器を介して設けられて．発生したフラーレン類がカーボンブラックと共に回収される。また、この実施の形態においては．炭素含有燃料ガスを中央のパイプ２３から供給し、酸素含有ガスをその周囲から供給しているが、中央のパイプ２３から酸素含有ガスをその周囲から炭素含有燃料ガスを流すこともできる。この場合は．蓄圧室１５、１６に供給されるガスも入れ代わる。そして、この実施の形態においては．挿通孔２２内に断面四角形のパイプ２３を入れたが．例えば図２（Ｂ）に示すように断面三角

形のパイプ２６とすることもできるし．その他の形状（例えば、五～八角形）とすることもできる。更には、挿通孔の断面形状に対してこれに挿入するパイプの形状が異なれば、同一又は類似の作用効果を発揮するので、このようなものにも本発明は適用される。

【００１２】次に、図３．図４に示す本発明の第２の実施の形態に係るフラーレン類の製造用バーナー２７及びこれを用いる製造装置２７ａについて説明するが．図１．図２の同一の構成要素については同一の番号を付してその詳しい説明を省略する（以下の実施の形態においても同じ）。第２の実施の形態に係るフラーレン類の製造用バーナー２７は、反応炉１１ｂの下部に設けられ、底板兼用のバーナーヘッド２８を有している。バーナーヘッド２８の下部には第１．第２の蓄圧室２９．３０が設けられ、第１の蓄圧室２９には炭素含有燃料ガスの供給口３１が、第２の蓄圧室３０には酸素含有ガスの供給口３２が設けられている。一方、バーナーヘッド２８には大小の挿通孔３３、３４が隣り合って均等に設けられている。小さい挿通孔３４は、第１の蓄圧室２９に連通しているが、大きい挿通孔３３には下端が第２の蓄圧室３０まで連通するパイプ（第２のパイプ）３５が挿通している。第１．第２の蓄圧室２９、３０の仕切り板３６は完全に密閉状態となって．蓄圧室２９、３０内のガスが混じらないようになっている。なお．この実施の形態ではパイプ３５は仕切り板３６を貫通して、仕切り板３６とパイプ３５の当接部分で溶接又は留付けが行われているが、仕切り板３６に貫通孔を設け．この貫通孔にパイプを連結するようにしてもよい（その他の実施の形態でも同じ）。パイプ３５の内径は、小さい挿通孔３４の内径と同じ程度が好ましいが、異なる場合であってもよい。また、パイプ３５はバーナーヘッド２８に密封状態で取付け、大きい挿通孔３３とパイプ３５の隙間をガスが通過しないようにするのが好ましいが、必須の要件ではない。

【００１３】大小の挿通孔３３、３４の間隔は．反応炉１１ｂの大きさにもよるが．通常２～２００ｍｍ程度であり．挿通孔３４の内径は１～１０ｍｍ程度が好ましいが．反応炉１１ｂの大きさに合わせて適宜調整する。これによって、挿通孔３４の先部が炭素含有燃料ガスの噴出口３７となり．パイプ３５の先部が酸素含有ガスの噴出口３８となる。これによって、反応炉１１ｂ内で炭素含有燃料ガスと酸素含有ガスが渦ざって燃焼し．バーナーヘッド２８内では、炭素含有燃料ガスと酸素含有ガスとが独立しているので、減圧及び低ガス流速であっても．逆火や爆発の危険性が全くない。従って、安定してフラーレンを製造できる。

【００１４】次に、図５～図７に示す第３の実施の形態に係るフラーレン類の製造用バーナー４０及びこれを用いた製造装置４１について説明する。この実施の形態においては、製造装置４１を構成する反応炉４２の底板４３に複数のフラーレン類の製造用バーナー４０が設けられている。底板４３は銅又はステンレス等の金属部材からなって、温度の上昇を防止するため所定温度の熱媒又は水によって冷却されている。フラーレン類の製造用バーナー４０を図６に示すが．基本的構造は、第１の実施の形態に係るフラーレン類の製造用バーナー１０と同一であって、上部のバーナーヘッド４４の下方（即ち、上流側）に、第１．第２の蓄圧室４５．４６を備えている。バーナーヘッド４４の周囲には冷却ジャケット部４７を備え、水等の冷媒が循環している。４８、４９はそれぞれ冷媒の入口及び出口である。バーナーヘッド４４を貫通する多数の挿通孔５０が設けられ、この挿通孔５０には一方が第２の蓄圧室４６まで延長された角パイプ５１（例えば．断面三角形～八角形）が挿通している。なお．第１、第２の蓄圧室４５、４６の仕切り板５２は完全に密閉されている。第１の蓄圧室４５には炭素含有燃料ガス又は酸素含有ガスのいずれか一方を供給する供給口５３が、第２の蓄圧室４６には炭素含有燃料ガス又は酸素含有ガスのいずれか他方を供給する供給口５４が設けられている。

【００１５】このようなフラーレン類の製造用バーナー４０が反応炉４２の底板４３には、図５に示すように、出来る限り密に配置されている。これによって．フラーレン類の製造用バーナー４０内では炭素含有燃料ガスと酸素含有ガスが独立のガス通路を通り．反応炉４２内に混合されるので．逆火等の心配がない。更には．フラーレン類の製造用バーナー４０が個々に分かれているので．製造が容易であり、更には故障の場合にも故障したフラーレン類の製造用バーナー４０のみを取り替えることによって補修ができる。この実施の形態では．フラーレン類の製造用バーナー４０自体に冷却ジャケット部４７を設けたが．フラーレン類の製造用バーナーには冷却ジャケット部は設けず、底板に冷却部を設けることもでき．これによって、更には密にフラーレン類の製造用バーナーを底板に配置できる。

【００１６】次に、図８に示す第４の実施の形態に係るフラーレン類の製造用バーナー５６について説明する。このフラーレン類の製造用バーナー５６は第３の実施の形態に係るフラーレン類の製造用バーナー４０の代わりに使用するものであり、底板４３に並べて使用する。そして．フラーレン類の製造用バーナー５６の基本的構成は．第２の実施の形態に係るフラーレン類の製造用バーナー２７と同一である。即ち、図８に示すように．フラーレン類の製造用バーナー５６は、バーナーヘッド５７の下方（即ち．上流側）に．第１、第２の蓄圧室５８、５９を有し、蓄圧室５８には炭素含有燃料ガス又は酸素含有ガスのいずれか一方が．蓄圧室５９には炭素含有燃料ガス又は酸素含有ガスのいずれか他方が導入される供給口６０、６１を備えている。バーナーヘッド５７には．径の大きい挿通孔６２と径の小さい挿通孔６３が形

成され、径の大きい挿通孔６２にはパイプ６４が挿通されている。パイプ６４の内径は挿通孔６３の内径と同等又は近似の値（例えば、０．５～３ｍｍ）となっている。第１、第２の蓄圧室５８、５９を区分けする仕切り板６５は密閉構造となって．貫通するパイプ６４の周囲は溶接又は蝋付けにて密閉されている。

【００１７】バーナーヘッド５７の中央には、径の比較的大きい噴出ノズル６５ａが設けられ．先部には複数のノズル小孔６６が形成されている。この噴出ノズル６５ａからは、炭素含有燃料ガス及び酸素含有ガスを除く他の物質（例えば．珪素、金属類、その他の無機物粉末、活性又は不活性ガス）を反応炉内に入れることが可能であり．必要に応じてフラーレン類の複合化合物を製造することができる。また、特別な場合として、炭素含有燃料ガスや酸素含有ガスを．反応炉内に吹き込むこともできる。この場合であっても．吹き込まれるガスはプリミックスされていないので．逆火等が起こることはなく、安定して操業ができる。この実施の形態ではバーナーヘッド本体は冷却構造としていないが．冷媒を循環させることも可能であり、更には．底板４３に冷却ジャケット部又は冷却パイプを設けて冷却することもできる。第３．第４の実施の形態に係るフラーレン類の製造用バーナー４０、５６を使用することによって、各バーナーを個別化することができ、より大型のフラーレン類の製造装置を構成することができる。第３．第４の実施の形態に係るフラーレン類の製造用バーナー４０、５６の周囲に取付けフランジを設けることによって、底板４３に容易に取外し可能となる。底板４３の表面でフラーレン類の製造用バーナー４０、５６の露出していない部分には適当に耐火物を貼ることもできる。

【００１８】本発明は前記個々の実施の形態に限定されるものではなく．前記実施の形態を組み合わせてフラーレン類の製造装置を構成する場合にも本発明は適用される。また、前記実施の形態においては．炭素含有燃料ガスとしては任意のものを使用でき、例えば、メタン、エタン．プロパン．エチレン．プロピレン等の直鎖又は分岐鎖を有する脂肪族飽和若しくは不飽和炭化水素．前記したベンゼン．トルエンの他、オルト．メタ、パラのキシレン、ナフタリン、アントラセン等の芳香族炭化水素やこれらの混合物等がある。前記したフラーレン類の製造用バーナーが使用される燃焼法は．フラーレン合成域における温度が他の方法に比較して低温であるので、大型の装置の構築が可能となり、フラーレンの大量生産に向く。燃焼法における燃焼方法や状態はフラーレンが生成する条件であれば、任意の条件を設定してよいが、一般的には、酸素（酸素ガスやオゾンガス）を主体とするガスを用いて前述の炭素水素原料を不完全燃焼させる方法を用いるが．この酸素にヘリウム．アルゴン等の不活性ガスと酸素の混合ガス（酸素含有ガス）を用いてもよい。この際の燃焼温度は．原料炭化水素の種類にもよるが．通常１０００～２１００℃、より好ましくは１２００～１７００℃程度である。また、燃焼における炭素含有燃料ガスと酸素含有ガスとの割合も適宜選択すればよいが．理論燃焼酸素含有ガス量に対して、より少ない酸素含有ガス量となる。また．反応炉内の圧力は．フラーレンが製造可能な圧力であれば任意であるが、一般的には．１０～６００ｔｏｒｒ．より好ましくは３０～１００ｔｏｒｒであるのがよい。なお、前記それぞれの実施の形態においては、フラレーン類の製造用バーナーは反応炉の底部に設けたが、その取付け位置及び方法は任意である。

【００１９】

【発明の効果】請求項１～８記載のフラーレン類の製造用バーナー及び請求項９記載のフラーレン類の製造方法は．以上の説明からも明らかなように．前記バーナーヘッド内での炭素含有燃料ガスと酸素含有ガスとの混合を防止している。これによって、バーナー内で炭素含有燃料ガスと酸素含有ガスの混合がないので、逆火等の心配がない。そして．噴出口Ｐと噴出口Ｑとは小間隔で多数混在しているので、噴出直後に炭素含有燃料ガスと酸素含有ガスが混ざり、より効率よくフラーレン類の製造が可能となる。特に、請求項２記載のフラーレン類の製造用バーナーにおいては、反応炉には複数のバーナーヘッドが設けられているので．バーナーヘッドをそれぞれ含む複数のバーナーの製造．メンテナンスが容易となる他．任意の数のフラーレン類の製造用バーナーを並べて大型の製造装置を構成できる。

【００２０】請求項３記載のフラーレン類の製造用バーナーにおいては．バーナーヘッドの上流側に、それぞれ隔絶した第１及び第２の蓄圧室を設けているので．それぞれ噴出口Ｐ及び噴出口Ｑから吐出されるガスの流れがより均一になり．より効率のよいフラーレン類の製造を期待できる。請求項４記載のフラーレン類の製造用バーナーにおいては．第１の蓄圧室からバーナーヘッドを貫通する挿通孔が設けられ．挿通孔内の断面形状とは異なる断面形状の第１のパイプが挿通孔を通って第２の蓄圧室まで延設され．第１のパイプが噴出口Ｑのガス通路を形成し、挿通孔と第１のパイプの隙間が噴出口Ｐのガス通路を形成しているので．バーナーヘッドに形成する挿通孔の数が減少し、より高い密度で噴出口Ｐ及び噴出口Ｑを形成できる。更には．炭素含有燃料ガスと酸素含有ガスとがより密接に接するので、両ガスの混合性が向上する。

【００２１】請求項５記載のフラーレン類の製造用バーナーは、挿通孔は断面円形であって．第１のパイプの断面は．三角～八角のいずれか１の形状（更に、好ましくは四角形）となっているので、製造が容易であると共に．第１のパイプの外側に確実なる噴出口を確保することができる。請求項６記載のフラーレン類の製造用バーナーにおいては．挿通孔は．バーナーヘッドに実質的に

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均等に配置されているので、ノズルヘッドからより均等にガスを放出することができ、結果として、より炭素含有燃料ガスと酸素含有ガスの混合を行うことができる。請求項７記載のフラーレン類の製造用バーナーは、第１の蓄圧室より第２の蓄圧室が上流側に設けられ、第１の蓄圧室からバーナーヘッドを貫通する挿通孔が設けられていると共に、バーナーヘッドには挿通孔とは別位置に、第１の蓄圧室を通って第２の蓄圧室からバーナーヘッドを貫通する第２のパイプが設けられ、挿通孔が噴出口Ｐのガス通路を形成し、第２のパイプが噴出口Ｑのガス通路を形成しているので、製造が容易で、かつガスの分散が確実となる。そして、請求項９記載のフラーレン類の製造方法は、請求項１～８記載のフラーレン類の製造用バーナーを用いてフラーレン類を製造しているので、安全性を高めてより大量のフラーレン類を効率よく製造することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態に係るフラーレン類の製造用バーナーを使用する製造装置の断面図である。

【図２】（Ａ）は図１における矢視Ａ－Ａ断面図、（Ｂ）は噴出口部分の変形例の説明図である。

【図３】本発明の第２の実施の形態に係るフラーレン類の製造用バーナーを用いた製造装置の断面図である。

【図４】図３における矢視Ｂ－Ｂ断面図である。

【図５】本発明の第３の実施の形態に係るフラーレン類の製造用バーナーを用いた製造装置の断面図である。

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＊【図６】同フラーレン類の製造用バーナーの詳細断面図である。

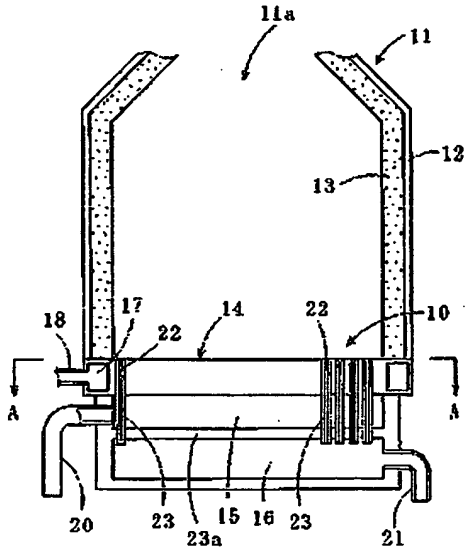
【図７】同平面図である。

【図８】本発明の第４の実施の形態に係るフラーレン類の製造用バーナーの断面図である。

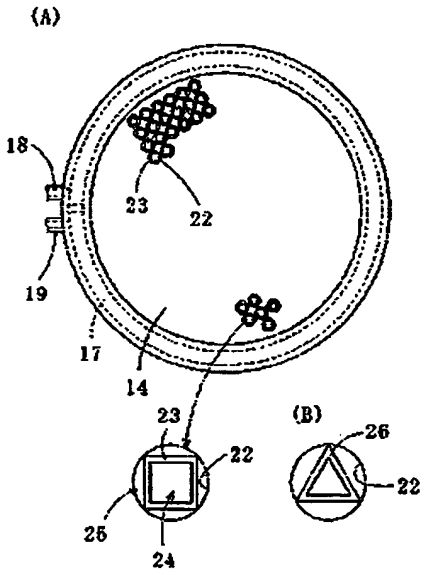
【符号の説明】

１０：フラーレン類の製造用バーナー、１１：製造装置、１１ａ、１１ｂ：反応炉、１２：炉壁、１３：耐火材、１４：バーナーヘッド、１５、１６：蓄圧室、１７：冷却ジャケット部、１８：入口、１９：出口、２０、２１：供給口、２２：挿通孔、２３：パイプ、２３ａ：仕切り板、２４、２５：噴出口、２６：パイプ、２７：フラーレン類の製造用バーナー、２７ａ：製造装置、２８：バーナーヘッド、２９、３０：蓄圧室、３１、３２：供給口、３３、３４：挿通孔、３５：パイプ、３６：仕切り板、３７、３８：噴出口、４０：フラーレン類の製造用バーナー、４１：製造装置、４２：反応炉、４３：底板、４４：バーナーヘッド、４５、４６：蓄圧室、４７：冷却ジャケット部、４８：入口、４９：出口、５０：挿通孔、５１：角パイプ、５２：仕切り板、５３、５４：供給口、５６：フラーレン類の製造用バーナー、５７：バーナーヘッド、５８、５９：蓄圧室、６０、６１：供給口、６２、６３：挿通孔、６４：パイプ、６５：仕切り板、６５ａ：噴出ノズル、６６：ノズル小孔

【図１】



【図２】



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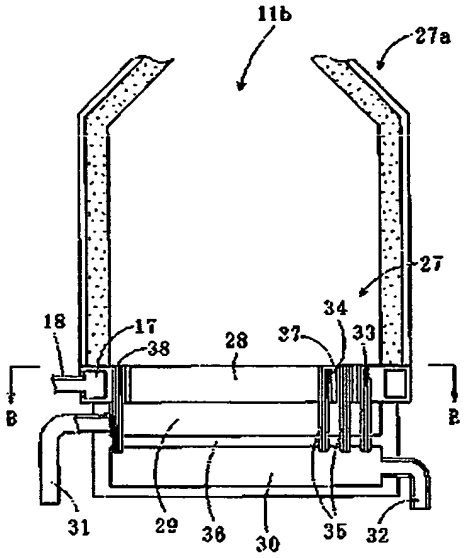
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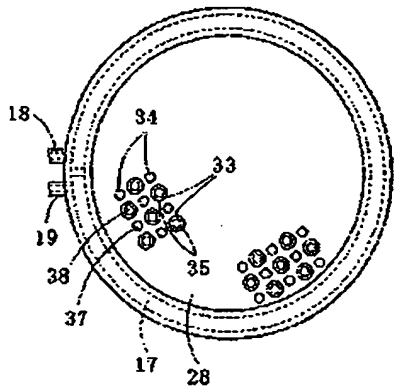
【図4】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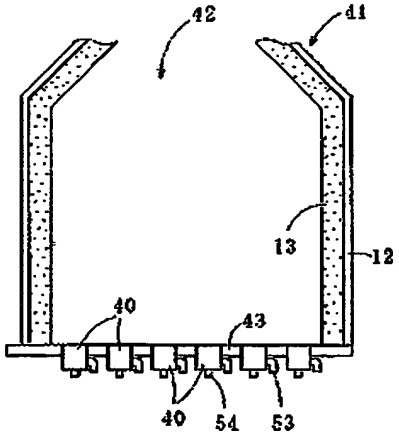
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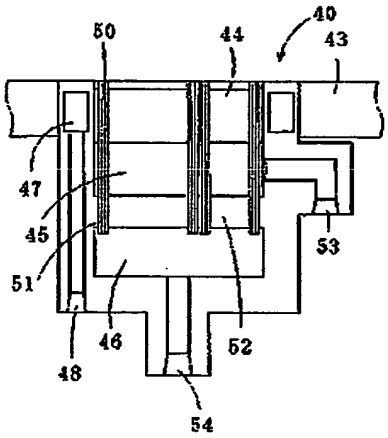
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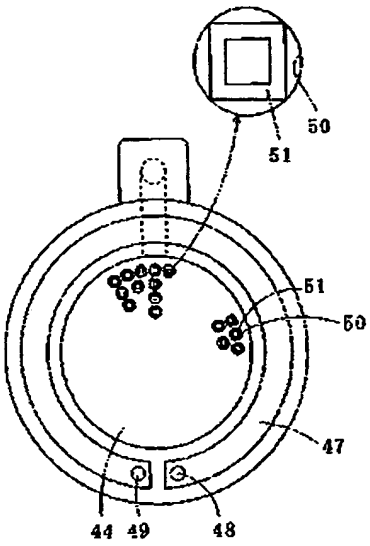
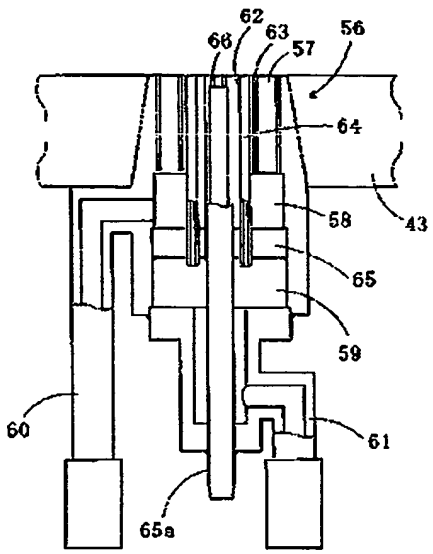
【図7】



【図8】



フロントページの続き

Fターム(参考) 3K017 CA05 CB02 CD01 CH04
3K019 AA05 BA04 BB03 BD11
4G046 CA01 CC09

CLAIMS

[Claim(s)]
[Claim 1] It is the burner for manufacture of the fullerene which draw carbon content fuel gas and oxygen content gas in said fission reactor from the burner head exposed to a fission reactor. To said burner head The exhaust nozzle P which passes said carbon content fuel gas or said oxygen content gas The exhaust nozzle Q which passes any of said carbon content fuel gas and said oxygen content gas or another side is intermingled, respectively, and are prepared at small spacing. [many] And said exhaust nozzle P and said exhaust nozzle Q are the burner for manufacture of the fullerene characterized by having had the gas passageway which became independent respectively and having prevented mixing with the carbon content fuel gas within said burner head, and oxygen content gas.
[Claim 2] The burner for manufacture of the fullerene characterized by preparing said two or more burner heads in said fission reactor in the burner for manufacture of fullerene according to claim 1.
[Claim 3] The burner for manufacture of the fullerene characterized by preparing the 1st and 2nd accumulators isolated to the upstream of said burner head, respectively in the burner for manufacture of fullerene according to claim 1 or 2, for the gas passageway of said exhaust nozzle P being open for free passage to said 1st accumulator, and the gas passageway of said exhaust nozzle Q being open for free passage to said 2nd accumulator.
[Claim 4] In the burner for manufacture of fullerene according to claim 3, said 2nd accumulator is prepared in the upstream from said 1st accumulator. The insertion hole which penetrates said burner head from this 1st accumulator is prepared. The 1st pipe of a different cross-section configuration from the cross-section configuration in this insertion hole is installed to said 2nd accumulator through this insertion hole. The burner for manufacture of the fullerene characterized by for said 1st pipe forming the gas passageway of said exhaust nozzle Q, and the clearance between said insertion hole and said 1st pipe forming the gas passageway of said exhaust nozzle P.
[Claim 5] the burner for manufacture of fullerene according to claim 4 -- setting -- said insertion hole -- a cross section -- the burner for manufacture of the fullerene characterized by being circular and the cross section of said 1st pipe serving as any 1 configuration of a trigonum - 8 angle.
[Claim 6] It is the burner for manufacture of the fullerene characterized by arranging said insertion hole equally substantially at said burner head in the burner for manufacture of fullerene according to claim 4 or 5.
[Claim 7] While said 2nd accumulator is prepared in the upstream from said 1st accumulator and the insertion hole which penetrates said burner head from said 1st accumulator is prepared in the burner for manufacture of fullerene according to claim 3 With said insertion hole, the 2nd pipe which penetrates said burner head from said 2nd accumulator through said 1st accumulator in another location is prepared in said burner head. The burner for manufacture of the fullerene characterized by for said insertion hole forming the gas passageway of said exhaust nozzle P, and said 2nd pipe forming the gas passageway of said exhaust nozzle Q.
[Claim 8] It is the burner for manufacture of the fullerene characterized by for said exhaust nozzle P and said exhaust nozzle Q adjoining said burner head equally substantially in the burner for manufacture of

fullerene according to claim 7, and being arranged.
[Claim 9] The manufacture approach of the fullerene which said carbon content fuel gas and said oxygen content gas are made to react to any 1 term of claims 1-8 in said fission reactor using the burner for manufacture of the fullerene of a publication, and manufacture fullerene.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the fullerene which used the burner for manufacture of fullerene (C60, C70, C76, C78, and C84 are included), and this.
[0002]
[Description of the Prior Art] Fullerene is the generic name of the third carbon allotrope which ranks second to a diamond and a graphite, and is the carbon molecule of the shape of hollow husks closed in a network of five membered-rings and six membered-rings which is represented by C60 and C70 grade. Although it is comparatively that existence of fullerene was finally checked and it is a comparatively new carbon material, it is admitted that a specific physical property is shown because of the special molecular structure, for example, innovative application development is being quickly developed over the wide range following fields.
(1) Since purification of the artificial diamond which has a fine crystal grain child by using application fullerene to a superhard ingredient as a precursor is attained, use to an abrasion resistance material with added value is expected.
(2) If metallic potassium is doped to the application fullerene thin film to drugs, it is discovered that a superconducting material with a high transition temperature called 18K can be made, and since various, attract attention.
(3) It uses that resist structure is further strengthened with mixing C60 with the application resist to a semiconductor device, and the application to next-generation semi-conductor manufacture is expected.
Also in the fullerene of various carbon numbers, C60 and C70 are comparatively easy to compound, and it is expected that future need so also increases explosively. As the manufacture approach of fullerene learned now, although there are laser vacuum deposition, a resistance heating method, an arc discharge method, a radio frequency heating method, a combustion method, a naphthalene thermal decomposition method, etc., the combustion method to which the incomplete combustion of the oxygen content gas of inert gas, such as helium, and oxygen and the hydrocarbon raw materials, such as benzene and toluene, is carried out all over a combustion furnace has a comparatively cheap manufacturing cost.
[0003]
[Problem(s) to be Solved by the Invention] In this combustion method, although the hydrocarbon raw material and oxygen content gas which were gasified in the combustion furnace, respectively are introduced and incomplete combustion is carried out under reduced pressure, if the fuel feed hopper and oxygen content gas supply opening which introduce hydrocarbon material gas and oxygen content gas separately, respectively are prepared in a combustion furnace and these are burned, since mixing of the ring main in a combustion furnace is imperfect, the yield of a combustion reaction of dispersion and fullerene is partially low. Then, if it blows off from many stomata (nozzle) in a combustion furnace after carrying out the premix of hydrocarbon material gas and the oxygen content gas within a burner, what is blown into a combustion furnace where ring main is mixed is performed, the miscibility of the ring main in a combustion furnace is secured, and it can expect to improve the yield of fullerene by this. However,

when a such premix type burner is used, a backfire may happen depending on an operating condition, and it becomes an especially serious problem in the case of the large-sized manufacture furnace in an industrial scale, therefore there is a problem that it is necessary to pay careful attention in the design of a burner. It aims at having been made in view of this situation, a backfire not happening, even if carbon content fuel gas and oxygen content gas blow off and it lowers a rate, but this invention being stabilized in a combustion furnace, and offering the manufacture approach of the burner for manufacture of the fullerene which can manufacture fullerene, and the fullerene using this.

[0004]

[Means for Solving the Problem] The burner for manufacture of the fullerene concerning the 1st invention in alignment with said purpose It is the burner for manufacture of the fullerene which draw carbon content fuel gas and oxygen content gas in said fission reactor from the burner head exposed to a fission reactor. To said burner head Said carbon content fuel gas or said oxygen content gas An exhaust nozzle P The exhaust nozzle Q which passes any of said carbon content fuel gas and said oxygen content gas or another side is intermingled, respectively, and are prepared at small spacing. [many] And said exhaust nozzle P and said exhaust nozzle Q had the gas passageway which became independent respectively, and have prevented mixing with the carbon content fuel gas within said burner head, and oxygen content gas. Since the gas which passes through an exhaust nozzle P and an exhaust nozzle Q is not mixed by this, even if it makes the rate of these gas late, there are no worries about a backfire. Furthermore, since many exhaust nozzles P and exhaust nozzles Q are intermingled at small spacing (for example, 0.5-100mm), carbon content fuel gas and oxygen content gas are mixed immediately after jet. Here, it is contained also when making into a subject ozone gas (O3) besides the pure oxygen gas which makes oxygen gas (O2) a subject at oxygen content gas, and the carbon content fuel gas below the explosion limit may be further included in the case where inert gas, such as helium and an argon, is included, and oxygen content gas. Moreover, oxygen gas and ozone gas below the explosion limit may be included in carbon content fuel gas. Furthermore, inert gas, such as helium and an argon, may be included in carbon content fuel gas.

[0005] In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 2nd invention requires for the 1st invention, said two or more burner heads are prepared in said fission reactor. By this, manufacture of two or more burners which contain a burner head, respectively, and a maintenance become easy. In the burner for manufacture of the fullerene concerning the 1st and 2nd invention, the 1st and 2nd accumulators isolated to the upstream of said burner head, respectively are prepared, the gas passageway of said exhaust nozzle P is open for free passage to said 1st accumulator, and the gas passageway of said exhaust nozzle Q is opening the burner for manufacture of the fullerene concerning the 3rd invention for free passage to said 2nd accumulator. By this, the flow of the gas breathed out from an exhaust nozzle P and an exhaust nozzle Q, respectively becomes homogeneity.

[0006] The burner for manufacture of the fullerene concerning the 4th invention In the burner for manufacture of the fullerene concerning the 3rd invention, said 2nd accumulator is prepared in the upstream from said 1st accumulator. The insertion hole which penetrates said burner head from this 1st accumulator is prepared. The 1st pipe of a different cross-section configuration from the cross-section configuration in this insertion hole is installed to said 2nd accumulator through this insertion hole, said 1st pipe forms the gas passageway of said exhaust nozzle Q, and the clearance between said insertion hole and said 1st pipe forms the gas passageway of said exhaust nozzle P. By this, the number of the insertion holes formed in a burner head decreases, and an exhaust nozzle P and an exhaust nozzle Q can be formed by the higher consistency. In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 5th invention requires for the 4th invention, said insertion hole is a cross-section round shape, and the cross section of said 1st pipe serves as any 1 configuration (still more preferably square) of a trigonum - 8 angle. By this, manufacture becomes easy. In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 6th invention requires for the 4th and 5th invention, said insertion hole is arranged equally substantially at said burner head. By this, gas can be more equally emitted from a nozzle head and mixing of carbon

content fuel gas and oxygen content gas can be performed more as a result.
[0007] The burner for manufacture of the fullerene concerning the 7th invention While said 2nd accumulator is prepared in the upstream from said 1st accumulator and the insertion hole which penetrates said burner head from said 1st accumulator is prepared in the burner for manufacture of the fullerene concerning the 3rd invention With said insertion hole, the 2nd pipe which penetrates said burner head from said 2nd accumulator through said 1st accumulator in another location is prepared in said burner head. Said insertion hole forms the gas passageway of said exhaust nozzle P, and said 2nd pipe forms the gas passageway of said exhaust nozzle Q. In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 8th invention requires for the 7th invention, said exhaust nozzle P and said exhaust nozzle Q adjoin said burner head equally substantially, and are arranged. By this, an exhaust nozzle P and an exhaust nozzle Q are detached for a while, it can arrange in another location, an exhaust nozzle P and exhaust nozzles Q can be made efficiently scattered as a whole, and the miscibility of carbon content fuel gas and oxygen content gas can be raised more. Since the manufacture approach of the fullerene concerning the 9th invention makes said carbon content fuel gas and said oxygen content gas react in said fission reactor and is manufacturing fullerene using the burner for manufacture of the fullerene concerning the 1st explained previously - the 8th invention, it is more efficient and the manufacture of fullerene of it made into the purpose is attained. In addition, it is what was used in order that P and Q might distinguish two exhaust nozzles, and there is no technical semantics.
[0008]
[Embodiment of the Invention] Then, referring to the attached drawing, it explains per gestalt of the operation which materialized this invention, and an understanding of this invention is presented. The sectional view of the manufacturing installation which uses the burner for manufacture of the fullerene which drawing 1 requires for the gestalt of operation of the 1st of this invention, A view A-A sectional view [in / in drawing 2 (A) / drawing 1], the explanatory view in which (B) shows the modification of an exhaust nozzle part, The sectional view of a manufacturing installation using the burner for manufacture of the fullerene which drawing 3 requires for the gestalt of operation of the 2nd of this invention, A view B-B sectional view [in / in drawing 4 / drawing 3], the sectional view of a manufacturing installation using the burner for manufacture of fullerene with which drawing 5 starts the gestalt of operation of the 3rd of this invention, Drawing 6 is the sectional view of the burner for manufacture of the fullerene which the detail sectional view of the burner for manufacture of the said fullerene and drawing 7 require for this top view, and drawing 8 requires for the gestalt of operation of the 4th of this invention.
[0009] The manufacturing installation 11 using the burner 10 for manufacture of fullerene and this concerning the gestalt of operation of the 1st of this invention shown in drawing 1 and drawing 2 is explained. The manufacturing installation 11 is equipped with fission reactor 11a which the carbon content fuel gas and oxygen content gas which are supplied from the lower part are made to react under a low voltage elevated temperature, and manufactures fullerene. It is cylindrical, this fission reactor 11a has the furnace wall 12 whose diameter the upper part reduces in the shape of a taper and which consists of a heat-resistant metal, and refractory material 13 is stuck on that inside. It had the burner 10 for manufacture of fullerene in the lower part of a furnace wall 12, and the burner 10 for manufacture of these fullerene is equipped with the tabular circular burner head 14 exposed to fission reactor 11a, the accumulator (the 1st accumulator) 15 of the oxygen content gas formed in that lower part, and the accumulator (the 2nd accumulator) 16 of the carbon content fuel gas further formed in that lower part. A burner head 14 consists of heat-resistant metals, such as stainless steel or copper, the diameter is about 20-300cm, and the cooling jacket section 17 is formed in the perimeter. In drawing 2 (A), 18 and 19 show the inlet port and outlet of a refrigerant which are connected with the cooling jacket section 17. Here, although water can also be used as a refrigerant, since the temperature of a burner head 14 falls, the heat carrier warmed suitably (for example, 150-350 degrees C) can also be used as a refrigerant (also setting in the gestalt of the following operations the same). By this, while preventing the fault rise of the temperature of a burner head 14, thermal efficiency is raised. Although the iron which is an example of a

metallic material, stainless steel, steel materials, copper, etc. can be used for the quality of the material of the cooling jacket section 17, when using a thermally conductive high ingredient like copper and brass especially aims at cooling of a burner head 14, it is desirable (also in the gestalt of the following operations, it is the same). The feed hopper 21 of the carbon content fuel gas which elevated temperatures, such as benzene and toluene, made the accumulator 16 evaporate [feed hopper / 20 / of the oxygen content gas which mixed inert gas and oxygen, such as helium or an argon] is formed in the accumulator 15. It is desirable that inert gas, such as a suitable quantity of helium or an argon, is contained also in this carbon content fuel gas. In the gestalt of this operation, and the gestalt of the following operations, since a gas stream flows upwards from the bottom, the bottom turns into the upstream and it serves as the downstream from the bottom.

[0010] It is possible to arrange a heater suitably [in order to prevent liquefaction of carbon content fuel gas, or in order to promote evaporation] for the 2nd accumulator 16, and it is still more nearly free to form a heater, in order to heat oxygen content gas also to the 1st accumulator 15 (also in the gestalt of the following operations, it is the same). As shown in drawing 2 (A), the insertion hole 22 of two or more cross-section round shapes penetrated in the vertical direction is equally formed in the burner head 14 in the predetermined pitch (for example, 3-30mm). Although the diameter of this insertion hole 22 is based also on a pitch with the adjacent insertion hole 22, it is about 2-20mm. And the pipe 23 of the square which is an example of a multiple pipe (the 1st pipe) is inserted in each insertion hole 22, respectively. Although the insertion hole 22 is open for free passage to the accumulator 15, it is opening the pipe 23 for free passage to the accumulator 16. It is blockaded completely and the oxygen content gas in an accumulator 15 and the carbon content fuel gas of an accumulator 16 mix diaphragm 23a of an accumulator 15 and an accumulator 16. On the other hand, as shown between the insertion hole 22 and a pipe 23 at the limb of drawing 2 (A), there are 4 clearances, oxygen content gas is sent in in fission reactor 11a from an accumulator 15 through this clearance, and carbon content fuel gas is sent in fission reactor 11a from an accumulator 16 through a pipe 23. Therefore, the tip of a pipe 23 serves as the exhaust nozzle 24 of carbon content fuel gas, and the amount of [excluding the part of a pipe 23 from the insertion hole 22] point becomes the exhaust nozzle 25 of oxygen content gas.

[0011] Moreover, since the gas passageway of carbon content fuel gas and oxygen content gas is divided as mentioned above, there is no fear of a backfire and the rate from exhaust nozzles 24 and 25 can be set as the optimal conditions which can manufacture fullerene. Moreover, from each pipe 23, since the perimeter to oxygen content gas is supplied for carbon content fuel gas, ring main is mixed in the place which came out of the exhaust nozzles 24 and 25 of a burner head 14. In order to collect from fission reactor 11a the products discharged with gas, a bag filter is prepared through a syngas cooler and the generated fullerene is collected with carbon black by this manufacturing installation 11. Moreover, in the gestalt of this operation, although carbon content fuel gas is supplied from the central pipe 23 and oxygen content gas is supplied from that perimeter, that perimeter to carbon content fuel gas can also be passed for oxygen content gas from the central pipe 23. In this case, the gas supplied to accumulators 15 and 16 also interchanges. And in the gestalt of this operation, although the pipe 23 of a cross-section square was put in in the insertion hole 22, as shown, for example in drawing 2 (B), it can also consider as the pipe 26 of a cross-section triangle, and can also consider as other configurations (for example, 5 - an octagon). Furthermore, if the configurations of the pipe inserted for receiving the cross-section configuration of an insertion hole differ, since the same or similar operation effectiveness will be demonstrated, this invention is applied also to such a thing.

[0012] Next, although manufacturing installation 27a using the burner 27 for manufacture of fullerene and this concerning the gestalt of operation of the 2nd of this invention shown in drawing 3 and drawing 4 is explained, drawing 1 and the number same about the same component of drawing 2 are attached, and the detailed explanation is omitted (also in the gestalt of the following operations, it is the same). The burner 27 for manufacture of the fullerene concerning the gestalt of the 2nd operation is formed in the lower part of fission reactor 11b, and has the burner head 28 of bottom plate combination. The 1st and 2nd accumulator 29 and 30 is formed in the lower part of a burner head 28, the feed hopper 31 of carbon content fuel gas is formed in the 1st accumulator 29, and the feed hopper 32 of oxygen content

gas is formed in the 2nd accumulator 30. On the other hand, the large and small insertion holes 33 and 34 adjoin each other, and it is equally prepared in the burner head 28. Although the small insertion hole 34 is open for free passage to the 1st accumulator 29, the pipe (the 2nd pipe) 35 which a lower limit opens for free passage to the 2nd accumulator 30 has inserted it in the large insertion hole 33. The diaphragm 36 of the 1st and 2nd accumulator 29 and 30 will be in a sealing condition completely, and the gas in an accumulator 29 and 30 will be mixed. In addition, although a pipe 35 penetrates a diaphragm 36 and welding or solder attachment is performed by the contact parts of a diaphragm 36 and a pipe 35 with the gestalt of this operation, a through tube is prepared in a diaphragm 36 and you may make it connect a pipe with this through tube (it is the same also with the gestalt of other operations). Although same extent as the bore of the small insertion hole 34 of the bore of a pipe 35 is desirable, it may be the case where it differs. Moreover, they are not indispensable requirements although it is desirable to attach a pipe 35 in a burner head 28 in the state of seal, and to make it gas not pass through the clearance between the large insertion hole 33 and a pipe 35.

[0013] Although it is usually about 2-200mm although spacing of the large and small insertion holes 33 and 34 is based also on the magnitude of fission reactor 11b, and the bore of the insertion hole 34 has about 1-10 desirablemm, according to the magnitude of fission reactor 11b, it adjusts suitably. By this, the point section of the insertion hole 34 serves as the exhaust nozzle 37 of carbon content fuel gas, and the point section of a pipe 35 serves as the exhaust nozzle 38 of oxygen content gas. Since carbon content fuel gas and oxygen content gas mixed and burned within fission reactor 11b by this and carbon content fuel gas and oxygen content gas have been independent within a burner head 28, even if it is reduced pressure and a low gas flow rate, there is neither a backfire nor the danger of explosion. Therefore, it is stabilized and fullerene can be manufactured.

[0014] Next, the manufacturing installation 41 using the burner 40 for manufacture of fullerene and this concerning the gestalt of the 3rd operation which show drawing 5 - drawing 7 is explained. In the gestalt of this operation, the burner 40 for manufacture of two or more fullerene is formed in the bottom plate 43 of the fission reactor 42 which constitutes a manufacturing installation 41. A bottom plate 43 consists of metal members, such as copper or stainless steel, and it is cooled with the heat carrier or water of predetermined temperature in order to prevent the rise of temperature. Although the burner 40 for manufacture of fullerene is shown in drawing 6 , fundamental structure is the same as that of the burner 10 for manufacture of the fullerene concerning the gestalt of the 1st operation, and is equipped with the 1st and 2nd accumulator 45 and 46 under the upside burner head 44 (namely, upstream). The perimeter of a burner head 44 is equipped with the cooling jacket section 47, and refrigerants, such as water, circulate. 48 and 49 are the inlet ports and outlets of a refrigerant, respectively. The insertion hole 50 of a large number which penetrate a burner head 44 was formed, and the square pipe steel 51 (for example, a cross-section triangle - an octagon) with which one side was extended to the 2nd accumulator 46 has inserted in this insertion hole 50. In addition, the diaphragm 52 of the 1st and 2nd accumulator 45 and 46 is sealed completely. The feed hopper 54 by which the feed hopper 53 which supplies either carbon content fuel gas or oxygen content gas supplies any of carbon content fuel gas or oxygen content gas or another side to the 2nd accumulator 46 is formed in the 1st accumulator 45.

[0015] The burner 40 for manufacture of such fullerene is arranged at the bottom plate 43 of a fission reactor 42 as densely as possible, as shown in drawing 5 . Since carbon content fuel gas and oxygen content gas pass along an independent gas passageway and are mixed in a fission reactor 42 within the burner 40 for manufacture of fullerene by this, there are no worries about a backfire etc. Furthermore, since the burner 40 for manufacture of fullerene is divided separately, manufacture is easy and repair is possible by exchanging only the burner 40 for manufacture of fullerene which broke down also when it was failure further. With the gestalt of this operation, although the cooling jacket section 47 was formed in burner 40 the very thing for manufacture of fullerene, the cooling jacket section cannot be prepared in the burner for manufacture of fullerene, but the cooling section can also be prepared in a bottom plate, and the burner for manufacture of fullerene can be arranged to a bottom plate still more densely by this.

[0016] Next, the burner 56 for manufacture of the fullerene concerning the gestalt of the 4th operation shown in drawing 8 is explained. The burner 56 for manufacture of these fullerene is used instead of the

burner 40 for manufacture of the fullerene concerning the gestalt of the 3rd operation, and is put in order and used for a bottom plate 43. And the fundamental configuration of the burner 56 for manufacture of fullerene is the same as that of the burner 27 for manufacture of the fullerene concerning the gestalt of the 2nd operation. that is, it is shown in drawing 8 -- as -- the burner 56 for manufacture of fullerene -- the lower part (namely, upstream) of a burner head 57 -- the 1st and 2nd accumulator 58 and 59 -- having -- an accumulator 58 -- either carbon content fuel gas or oxygen content gas -- an accumulator 59 -- either carbon content fuel gas or oxygen content gas -- it has the feed hoppers 60 and 61 into which another side is introduced. The large insertion hole 62 of a path and the small insertion hole 63 of a path are formed in a burner head 57, and the pipe 64 is inserted in the large insertion hole 62 of a path. The bore of a pipe 64 serves as a bore of the insertion hole 63, an EQC, or an approximate value (for example, 0.5-3mm). The diaphragm 65 which classifies the 1st and 2nd accumulator 58 and 59 serves as sealing structure, and the perimeter of the pipe 64 to penetrate is sealed by welding or solder attachment.

[0017] Comparatively large jet nozzle 65a of a path is prepared in the center of a burner head 57, and two or more nozzle stomata 66 are formed in it at the point section. From this jet nozzle 65a, it is possible to put in other matter (for example, silicon, metals, other inorganic substance powder, activity, or inert gas) except carbon content fuel gas and oxygen content gas in a fission reactor, and the conjugated compound of fullerene can be manufactured if needed. Moreover, when special, carbon content fuel gas and oxygen content gas can also be blown [******] into a fission reactor. Even if it is this case, since the premix of the gas blown is not carried out, a backfire etc. does not happen, it is stabilized and operation can do it. With the gestalt of this operation, although not considered as cooling structure, the burner-head body is possible also for circulating a refrigerant, further, can prepare the cooling jacket section or a cooling pipe in a bottom plate 43, and can also be cooled to it. By using the burners 40 and 56 for manufacture of the 3rd and the fullerene concerning the gestalt of the 4th operation, each burner can be changed an individual exception and the manufacturing installation of more large-sized fullerene can be constituted. By preparing a mounting flange in the perimeter of the burners 40 and 56 for manufacture of the 3rd and the fullerene concerning the gestalt of the 4th operation, it demounts to a bottom plate 43 simply, and becomes possible. Refractories can also be suitably stuck on the part which has not exposed the burners 40 and 56 for manufacture of fullerene on the front face of a bottom plate 43.

[0018] This invention is not limited to the gestalt of operation of said each, and this invention is applied also when it constitutes the manufacturing installation of fullerene combining the gestalt of said operation. Moreover, in the gestalt of said operation, there are aromatic hydrocarbon, such mixture, etc., such as alt.** meta besides the aliphatic series saturation which can use the thing of arbitration as carbon content fuel gas, for example, has a straight chain or branched chain, such as methane, ethane, a propane, ethylene, and a propylene, or unsaturated hydrocarbon, the above mentioned benzene, and toluene, a xylene of Para, naphthalene, and an anthracene. Since the temperature in a fullerene composition region is low temperature as compared with other approaches, construction of large-sized equipment of the combustion method with which the above mentioned burner for manufacture of fullerene is used is attained, and it is fit for mass production method of fullerene. Although the approach of generally carrying out the incomplete combustion of the above-mentioned carbon hydrogen raw material using the gas which makes oxygen (oxygen gas and ozone gas) a subject although the conditions of arbitration may be set up will be used if the combustion methods and conditions in a combustion method are conditions which fullerene generates, the mixed gas (oxygen content gas) of inert gas, such as helium and an argon, and oxygen may be used for this oxygen. Although the combustion temperature in this case is based also on the class of coal-for-coke-making-ized hydrogen, it is usually about 1200-1700 degrees C more preferably 1000-2100 degrees C. Moreover, although what is necessary is just to also choose suitably the rate of the carbon content fuel gas and oxygen content gas in combustion, it becomes smaller oxygen content capacity to stoichiometric combustion oxygen content capacity. Moreover, although the pressure in a fission reactor is arbitrary if it is a pressure which can manufacture fullerene, generally it is good that it is 30 - 100torr more preferably ten to 600 torr. In

addition, in the gestalt of said the operation of each, although the burner for manufacture of hula lanes was formed in the pars basilaris ossis occipitalis of a fission reactor, the fitting location and approach are arbitrary.

[0019]

[Effect of the Invention] The manufacture approach of the burner for manufacture of fullerene according to claim 1 to 8 and fullerene according to claim 9 has prevented mixing with the carbon content fuel gas within said burner head, and oxygen content gas so that clearly also from the above explanation. By this, since there is no mixing of carbon content fuel gas and oxygen content gas within a burner, there are no worries about a backfire etc. And since many exhaust nozzles P and exhaust nozzles Q are intermingled at small spacing, carbon content fuel gas and oxygen content gas are mixed immediately after jet, it is more efficient and the manufacture of fullerene of them is attained. Especially, since two or more burner heads are prepared in the fission reactor in the burner for manufacture of fullerene according to claim 2, manufacture of two or more burners which contain a burner head, respectively, and a maintenance become easy, and also the burner for manufacture of the fullerene of the number of arbitration is put in order, and a large-sized manufacturing installation can be constituted.

[0020] In the burner for manufacture of fullerene according to claim 3, since the 1st and 2nd accumulators isolated to the upstream of a burner head, respectively are prepared, the flow of the gas breathed out from an exhaust nozzle P and an exhaust nozzle Q, respectively becomes homogeneity more, and manufacture of more efficient fullerene can be expected. In the burner for manufacture of fullerene according to claim 4 The insertion hole which penetrates a burner head from the 1st accumulator is prepared, and the 1st pipe of a different cross-section configuration from the cross-section configuration in an insertion hole is installed to the 2nd accumulator through an insertion hole. Since the 1st pipe forms the gas passageway of an exhaust nozzle Q and the clearance between an insertion hole and the 1st pipe forms the gas passageway of an exhaust nozzle P, the number of the insertion holes formed in a burner head decreases, and an exhaust nozzle P and an exhaust nozzle Q can be formed by the higher consistency. Furthermore, since carbon content fuel gas and oxygen content gas touch more closely, the miscibility of ring main improves.

[0021] The insertion hole of the burner for manufacture of fullerene according to claim 5 is a cross-section round shape, and since the cross section of the 1st pipe serves as any 1 configuration (still more preferably square) of a trigonum - 8 angle, while manufacture is easy, a positive exhaust nozzle is securable for the outside of the 1st pipe. In the burner for manufacture of fullerene according to claim 6, since the insertion hole is arranged equally substantially at the burner head, it can emit gas more equally from a nozzle head, and can perform mixing of carbon content fuel gas and oxygen content gas more as a result. The burner for manufacture of fullerene according to claim 7 While the 2nd accumulator is prepared in the upstream from the 1st accumulator and the insertion hole which penetrates a burner head from the 1st accumulator is prepared With an insertion hole, the 2nd pipe which penetrates a burner head from the 2nd accumulator through the 1st accumulator in another location is prepared in a burner head. Since an insertion hole forms the gas passageway of an exhaust nozzle P and the 2nd pipe forms the gas passageway of an exhaust nozzle Q, it becomes certain easily dissociating [of gas] manufacture. And since the manufacture approach of fullerene according to claim 9 is manufacturing fullerene using the burner for manufacture of fullerene according to claim 1 to 8, it can raise safety and can manufacture a lot of fullerene efficiently.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the manufacture approach of the fullerene which used the burner for manufacture of fullerene (C60, C70, C76, C78, and C84 are included), and this.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Fullerene is the generic name of the third carbon allotrope which ranks second to a diamond and a graphite, and is the carbon molecule of the shape of hollow husks closed in a network of five membered-rings and six membered-rings which is represented by C60 and C70 grade. Although it is comparatively that existence of fullerene was finally checked and it is a comparatively new carbon material, it is admitted that a specific physical property is shown because of the special molecular structure, for example, innovative application development is being quickly developed over the wide range following fields.
(1) Since purification of the artificial diamond which has a fine crystal grain child by using application fullerene to a superhard ingredient as a precursor is attained, use to an abrasion resistance material with added value is expected.
(2) If metallic potassium is doped to the application fullerene thin film to drugs, it is discovered that a superconducting material with a high transition temperature called 18K can be made, and since various, attract attention.
(3) It uses that resist structure is further strengthened with mixing C60 with the application resist to a semiconductor device, and the application to next-generation semi-conductor manufacture is expected.
Also in the fullerene of various carbon numbers, C60 and C70 are comparatively easy to compound, and it is expected that future need so also increases explosively. As the manufacture approach of fullerene learned now, although there are laser vacuum deposition, a resistance heating method, an arc discharge method, a radio frequency heating method, a combustion method, a naphthalene thermal decomposition method, etc., the combustion method to which the incomplete combustion of the oxygen content gas of inert gas, such as helium, and oxygen and the hydrocarbon raw materials, such as benzene and toluene, is carried out all over a combustion furnace has a comparatively cheap manufacturing cost.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] The manufacture approach of the burner for manufacture of fullerene according to claim 1 to 8 and fullerene according to claim 9 has prevented mixing with the carbon content fuel gas within said burner head, and oxygen content gas so that clearly also from the above explanation. By this, since there is no mixing of carbon content fuel gas and oxygen content gas within a burner, there are no worries about a backfire etc. And since many exhaust nozzles P and exhaust nozzles Q are intermingled at small spacing, carbon content fuel gas and oxygen content gas are mixed immediately after jet, it is more efficient and the manufacture of fullerene of them is attained. Especially, since two or more burner heads are prepared in the fission reactor in the burner for manufacture of fullerene according to claim 2, manufacture of two or more burners which contain a burner head, respectively, and a maintenance become easy, and also the burner for manufacture of the fullerene of the number of arbitration is put in order, and a large-sized manufacturing installation can be constituted.
[0020] In the burner for manufacture of fullerene according to claim 3, since the 1st and 2nd accumulators isolated to the upstream of a burner head, respectively are prepared, the flow of the gas breathed out from an exhaust nozzle P and an exhaust nozzle Q, respectively becomes homogeneity more, and manufacture of more efficient fullerene can be expected. In the burner for manufacture of fullerene according to claim 4, The insertion hole which penetrates a burner head from the 1st accumulator is prepared, and the 1st pipe of a different cross-section configuration from the cross-section configuration in an insertion hole is installed to the 2nd accumulator through an insertion hole. Since the 1st pipe forms the gas passageway of an exhaust nozzle Q and the clearance between an insertion hole and the 1st pipe forms the gas passageway of an exhaust nozzle P, the number of the insertion holes formed in a burner head decreases, and an exhaust nozzle P and an exhaust nozzle Q can be formed by the higher consistency. Furthermore, since carbon content fuel gas and oxygen content gas touch more closely, the miscibility of ring main improves.
[0021] The insertion hole of the burner for manufacture of fullerene according to claim 5 is a cross-section round shape, and since the cross section of the 1st pipe serves as any 1 configuration (still more preferably square) of a trigonum - 8 angle, while manufacture is easy, a positive exhaust nozzle is securable for the outside of the 1st pipe. In the burner for manufacture of fullerene according to claim 6, since the insertion hole is arranged equally substantially at the burner head, it can emit gas more equally from a nozzle head, and can perform mixing of carbon content fuel gas and oxygen content gas more as a result. The burner for manufacture of fullerene according to claim 7, While the 2nd accumulator is prepared in the upstream from the 1st accumulator and the insertion hole which penetrates a burner head from the 1st accumulator is prepared With an insertion hole, the 2nd pipe which penetrates a burner head from the 2nd accumulator through the 1st accumulator in another location is prepared in a burner head. Since an insertion hole forms the gas passageway of an exhaust nozzle P and the 2nd pipe forms the gas passageway of an exhaust nozzle Q, it becomes certain easily dissociating [of gas] manufacture. And since the manufacture approach of fullerene according to claim 9 is manufacturing fullerene using the burner for manufacture of fullerene according to claim 1 to 8, it can raise safety and can manufacture a lot of fullerene efficiently.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In this combustion method, although the hydrocarbon raw material and oxygen content gas which were gasified in the combustion furnace, respectively are introduced and incomplete combustion is carried out under reduced pressure, if the fuel feed hopper and oxygen content gas supply opening which introduce hydrocarbon material gas and oxygen content gas separately, respectively are prepared in a combustion furnace and these are burned, since mixing of the ring main in a combustion furnace is imperfect, the yield of a combustion reaction of dispersion and fullerene is partially low. Then, if it blows off from many stomata (nozzle) in a combustion furnace after carrying out the premix of hydrocarbon material gas and the oxygen content gas within a burner, what is blown into a combustion furnace where ring main is mixed is performed, the miscibility of the ring main in a combustion furnace is secured, and it can expect to improve the yield of fullerene by this. However, when a such premix type burner is used, a backfire may happen depending on an operating condition, and it becomes an especially serious problem in the case of the large-sized manufacture furnace in an industrial scale, therefore there is a problem that it is necessary to pay careful attention in the design of a burner. It aims at having been made in view of this situation, a backfire not happening, even if carbon content fuel gas and oxygen content gas blow off and it lowers a rate, but this invention being stabilized in a combustion furnace, and offering the manufacture approach of the burner for manufacture of the fullerene which can manufacture fullerene, and the fullerene using this.

[Translation done.]

MEANS

[Means for Solving the Problem] The burner for manufacture of the fullerene concerning the 1st invention in alignment with said purpose It is the burner for manufacture of the fullerene which draw carbon content fuel gas and oxygen content gas in said fission reactor from the burner head exposed to a fission reactor. To said burner head Said carbon content fuel gas or said oxygen content gas An exhaust nozzle P The exhaust nozzle Q which passes any of said carbon content fuel gas and said oxygen content gas or another side is intermingled, respectively, and are prepared at small spacing. [many] And said exhaust nozzle P and said exhaust nozzle Q had the gas passageway which became independent respectively, and have prevented mixing with the carbon content fuel gas within said burner head, and oxygen content gas. Since the gas which passes through an exhaust nozzle P and an exhaust nozzle Q is not mixed by this, even if it makes the rate of these gas late, there are no worries about a backfire. Furthermore, since many exhaust nozzles P and exhaust nozzles Q are intermingled at small spacing (for example, 0.5-100mm), carbon content fuel gas and oxygen content gas are mixed immediately after jet. Here, it is contained also when making into a subject ozone gas (O3) besides the pure oxygen gas which makes oxygen gas (O2) a subject at oxygen content gas, and the carbon content fuel gas below the explosion limit may be further included in the case where inert gas, such as helium and an argon, is included, and oxygen content gas. Moreover, oxygen gas and ozone gas below the explosion limit may be included in carbon content fuel gas. Furthermore, inert gas, such as helium and an argon, may be included in carbon content fuel gas.

[0005] In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 2nd invention requires for the 1st invention, said two or more burner heads are prepared in said fission reactor. By this, manufacture of two or more burners which contain a burner head, respectively, and a maintenance become easy. In the burner for manufacture of the fullerene concerning the 1st and 2nd invention, the 1st and 2nd accumulators isolated to the upstream of said burner head, respectively are prepared, the gas passageway of said exhaust nozzle P is open for free passage to said 1st accumulator, and the gas passageway of said exhaust nozzle Q is opening the burner for manufacture of the fullerene concerning the 3rd invention for free passage to said 2nd accumulator. By this, the flow of the gas breathed out from an exhaust nozzle P and an exhaust nozzle Q, respectively becomes homogeneity.

[0006] The burner for manufacture of the fullerene concerning the 4th invention In the burner for manufacture of the fullerene concerning the 3rd invention, said 2nd accumulator is prepared in the upstream from said 1st accumulator. The insertion hole which penetrates said burner head from this 1st accumulator is prepared. The 1st pipe of a different cross-section configuration from the cross-section configuration in this insertion hole is installed to said 2nd accumulator through this insertion hole, said 1st pipe forms the gas passageway of said exhaust nozzle Q, and the clearance between said insertion hole and said 1st pipe forms the gas passageway of said exhaust nozzle P. By this, the number of the insertion holes formed in a burner head decreases, and an exhaust nozzle P and an exhaust nozzle Q can be formed by the higher consistency. In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 5th invention requires for the 4th invention, said insertion

hole is a cross-section round shape, and the cross section of said 1st pipe serves as any 1 configuration (still more preferably square) of a trigonum - 8 angle. By this, manufacture becomes easy. In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 6th invention requires for the 4th and 5th invention, said insertion hole is arranged equally substantially at said burner head. By this, gas can be more equally emitted from a nozzle head and mixing of carbon content fuel gas and oxygen content gas can be performed more as a result.

[0007] The burner for manufacture of the fullerene concerning the 7th invention While said 2nd accumulator is prepared in the upstream from said 1st accumulator and the insertion hole which penetrates said burner head from said 1st accumulator is prepared in the burner for manufacture of the fullerene concerning the 3rd invention With said insertion hole, the 2nd pipe which penetrates said burner head from said 2nd accumulator through said 1st accumulator in another location is prepared in said burner head. Said insertion hole forms the gas passageway of said exhaust nozzle P, and said 2nd pipe forms the gas passageway of said exhaust nozzle Q. In the burner for manufacture of the fullerene which the burner for manufacture of the fullerene concerning the 8th invention requires for the 7th invention, said exhaust nozzle P and said exhaust nozzle Q adjoin said burner head equally substantially, and are arranged. By this, an exhaust nozzle P and an exhaust nozzle Q are detached for a while, it can arrange in another location, an exhaust nozzle P and exhaust nozzles Q can be made efficiently scattered as a whole, and the miscibility of carbon content fuel gas and oxygen content gas can be raised more. Since the manufacture approach of the fullerene concerning the 9th invention makes said carbon content fuel gas and said oxygen content gas react in said fission reactor and is manufacturing fullerene using the burner for manufacture of the fullerene concerning the 1st explained previously - the 8th invention, it is more efficient and the manufacture of fullerene of it made into the purpose is attained. In addition, it is what was used in order that P and Q might distinguish two exhaust nozzles, and there is no technical semantics.

[0008]

[Embodiment of the Invention] Then, referring to the attached drawing, it explains per gestalt of the operation which materialized this invention, and an understanding of this invention is presented. The sectional view of the manufacturing installation which uses the burner for manufacture of the fullerene which drawing 1 requires for the gestalt of operation of the 1st of this invention, A view A-A sectional view [in / in drawing 2 (A) / drawing 1], the explanatory view in which (B) shows the modification of an exhaust nozzle part, The sectional view of a manufacturing installation using the burner for manufacture of the fullerene which drawing 3 requires for the gestalt of operation of the 2nd of this invention, A view B-B sectional view [in / in drawing 4 / drawing 3], the sectional view of a manufacturing installation using the burner for manufacture of fullerene with which drawing 5 starts the gestalt of operation of the 3rd of this invention, Drawing 6 is the sectional view of the burner for manufacture of the fullerene which the detail sectional view of the burner for manufacture of the said fullerene and drawing 7 require for this top view, and drawing 8 requires for the gestalt of operation of the 4th of this invention.

[0009] The manufacturing installation 11 using the burner 10 for manufacture of fullerene and this concerning the gestalt of operation of the 1st of this invention shown in drawing 1 and drawing 2 is explained. The manufacturing installation 11 is equipped with fission reactor 11a which the carbon content fuel gas and oxygen content gas which are supplied from the lower part are made to react under a low voltage elevated temperature, and manufactures fullerene. It is cylindrical, this fission reactor 11a has the furnace wall 12 whose diameter the upper part reduces in the shape of a taper and which consists of a heat-resistant metal, and refractory material 13 is stuck on that inside. It had the burner 10 for manufacture of fullerene in the lower part of a furnace wall 12, and the burner 10 for manufacture of these fullerene is equipped with the tabular circular burner head 14 exposed to fission reactor 11a, the accumulator (the 1st accumulator) 15 of the oxygen content gas formed in that lower part, and the accumulator (the 2nd accumulator) 16 of the carbon content fuel gas further formed in that lower part. A burner head 14 consists of heat-resistant metals, such as stainless steel or copper, the diameter is about 20-300cm, and the cooling jacket section 17 is formed in the perimeter. In drawing 2 (A), 18 and 19

show the inlet port and outlet of a refrigerant which are connected with the cooling jacket section 17. Here, although water can also be used as a refrigerant, since the temperature of a burner head 14 falls, the heat carrier warmed suitably (for example, 150-350 degrees C) can also be used as a refrigerant (also setting in the gestalt of the following operations the same). By this, while preventing the fault rise of the temperature of a burner head 14, thermal efficiency is raised. Although the iron which is an example of a metallic material, stainless steel, steel materials, copper, etc. can be used for the quality of the material of the cooling jacket section 17, when using a thermally conductive high ingredient like copper and brass especially aims at cooling of a burner head 14, it is desirable (also in the gestalt of the following operations, it is the same). The feed hopper 21 of the carbon content fuel gas which elevated temperatures, such as benzene and toluene, made the accumulator 16 evaporate [feed hopper / 20 / of the oxygen content gas which mixed inert gas and oxygen, such as helium or an argon] is formed in the accumulator 15. It is desirable that inert gas, such as a suitable quantity of helium or an argon, is contained also in this carbon content fuel gas. In the gestalt of this operation, and the gestalt of the following operations, since a gas stream flows upwards from the bottom, the bottom turns into the upstream and it serves as the downstream from the bottom.

[0010] It is possible to arrange a heater suitably [in order to prevent liquefaction of carbon content fuel gas, or in order to promote evaporation] for the 2nd accumulator 16, and it is still more nearly free to form a heater, in order to heat oxygen content gas also to the 1st accumulator 15 (also in the gestalt of the following operations, it is the same). As shown in drawing 2 (A), the insertion hole 22 of two or more cross-section round shapes penetrated in the vertical direction is equally formed in the burner head 14 in the predetermined pitch (for example, 3-30mm). Although the diameter of this insertion hole 22 is based also on a pitch with the adjacent insertion hole 22, it is about 2-20mm. And the pipe 23 of the square which is an example of a multiple pipe (the 1st pipe) is inserted in each insertion hole 22, respectively. Although the insertion hole 22 is open for free passage to the accumulator 15, it is opening the pipe 23 for free passage to the accumulator 16. It is blockaded completely and the oxygen content gas in an accumulator 15 and the carbon content fuel gas of an accumulator 16 mix diaphragm 23a of an accumulator 15 and an accumulator 16. On the other hand, as shown between the insertion hole 22 and a pipe 23 at the limb of drawing 2 (A), there are 4 clearances, oxygen content gas is sent in in fission reactor 11a from an accumulator 15 through this clearance, and carbon content fuel gas is sent in fission reactor 11a from an accumulator 16 through a pipe 23. Therefore, the tip of a pipe 23 serves as the exhaust nozzle 24 of carbon content fuel gas, and the amount of [excluding the part of a pipe 23 from the insertion hole 22] point becomes the exhaust nozzle 25 of oxygen content gas.

[0011] Moreover, since the gas passageway of carbon content fuel gas and oxygen content gas is divided as mentioned above, there is no fear of a backfire and the rate from exhaust nozzles 24 and 25 can be set as the optimal conditions which can manufacture fullerene. Moreover, from each pipe 23, since the perimeter to oxygen content gas is supplied for carbon content fuel gas, ring main is mixed in the place which came out of the exhaust nozzles 24 and 25 of a burner head 14. In order to collect from fission reactor 11a the products discharged with gas, a bag filter is prepared through a syngas cooler and the generated fullerene is collected with carbon black by this manufacturing installation 11. Moreover, in the gestalt of this operation, although carbon content fuel gas is supplied from the central pipe 23 and oxygen content gas is supplied from that perimeter, that perimeter to carbon content fuel gas can also be passed for oxygen content gas from the central pipe 23. In this case, the gas supplied to accumulators 15 and 16 also interchanges. And in the gestalt of this operation, although the pipe 23 of a cross-section square was put in in the insertion hole 22, as shown, for example in drawing 2 (B), it can also consider as the pipe 26 of a cross-section triangle, and can also consider as other configurations (for example, 5 - an octagon). Furthermore, if the configurations of the pipe inserted for receiving the cross-section configuration of an insertion hole differ, since the same or similar operation effectiveness will be demonstrated, this invention is applied also to such a thing.

[0012] Next, although manufacturing installation 27a using the burner 27 for manufacture of fullerene and this concerning the gestalt of operation of the 2nd of this invention shown in drawing 3 and drawing 4 is explained, drawing 1 and the number same about the same component of drawing 2 are attached,

and the detailed explanation is omitted (also in the gestalt of the following operations, it is the same). The burner 27 for manufacture of the fullerene concerning the gestalt of the 2nd operation is formed in the lower part of fission reactor 11b, and has the burner head 28 of bottom plate combination. The 1st and 2nd accumulator 29 and 30 is formed in the lower part of a burner head 28, the feed hopper 31 of carbon content fuel gas is formed in the 1st accumulator 29, and the feed hopper 32 of oxygen content gas is formed in the 2nd accumulator 30. On the other hand, the large and small insertion holes 33 and 34 adjoin each other, and it is equally prepared in the burner head 28. Although the small insertion hole 34 is open for free passage to the 1st accumulator 29, the pipe (the 2nd pipe) 35 which a lower limit opens for free passage to the 2nd accumulator 30 has inserted it in the large insertion hole 33. The diaphragm 36 of the 1st and 2nd accumulator 29 and 30 will be in a sealing condition completely, and the gas in an accumulator 29 and 30 will be mixed. In addition, although a pipe 35 penetrates a diaphragm 36 and welding or solder attachment is performed by the contact parts of a diaphragm 36 and a pipe 35 with the gestalt of this operation, a through tube is prepared in a diaphragm 36 and you may make it connect a pipe with this through tube (it is the same also with the gestalt of other operations). Although same extent as the bore of the small insertion hole 34 of the bore of a pipe 35 is desirable, it may be the case where it differs. Moreover, they are not indispensable requirements although it is desirable to attach a pipe 35 in a burner head 28 in the state of seal, and to make it gas not pass through the clearance between the large insertion hole 33 and a pipe 35.

[0013] Although it is usually about 2-200mm although spacing of the large and small insertion holes 33 and 34 is based also on the magnitude of fission reactor 11b, and the bore of the insertion hole 34 has about 1-10 desirablemm, according to the magnitude of fission reactor 11b, it adjusts suitably. By this, the point section of the insertion hole 34 serves as the exhaust nozzle 37 of carbon content fuel gas, and the point section of a pipe 35 serves as the exhaust nozzle 38 of oxygen content gas. Since carbon content fuel gas and oxygen content gas mixed and burned within fission reactor 11b by this and carbon content fuel gas and oxygen content gas have been independent within a burner head 28, even if it is reduced pressure and a low gas flow rate, there is neither a backfire nor the danger of explosion. Therefore, it is stabilized and fullerene can be manufactured.

[0014] Next, the manufacturing installation 41 using the burner 40 for manufacture of fullerene and this concerning the gestalt of the 3rd operation which show drawing 5 - drawing 7 is explained. In the gestalt of this operation, the burner 40 for manufacture of two or more fullerene is formed in the bottom plate 43 of the fission reactor 42 which constitutes a manufacturing installation 41. A bottom plate 43 consists of metal members, such as copper or stainless steel, and it is cooled with the heat carrier or water of predetermined temperature in order to prevent the rise of temperature. Although the burner 40 for manufacture of fullerene is shown in drawing 6 , fundamental structure is the same as that of the burner 10 for manufacture of the fullerene concerning the gestalt of the 1st operation, and is equipped with the 1st and 2nd accumulator 45 and 46 under the upside burner head 44 (namely, upstream). The perimeter of a burner head 44 is equipped with the cooling jacket section 47, and refrigerants, such as water, circulate. 48 and 49 are the inlet ports and outlets of a refrigerant, respectively. The insertion hole 50 of a large number which penetrate a burner head 44 was formed, and the square pipe steel 51 (for example, a cross-section triangle - an octagon) with which one side was extended to the 2nd accumulator 46 has inserted in this insertion hole 50. In addition, the diaphragm 52 of the 1st and 2nd accumulator 45 and 46 is sealed completely. The feed hopper 54 by which the feed hopper 53 which supplies either carbon content fuel gas or oxygen content gas supplies any of carbon content fuel gas or oxygen content gas or another side to the 2nd accumulator 46 is formed in the 1st accumulator 45.

[0015] The burner 40 for manufacture of such fullerene is arranged at the bottom plate 43 of a fission reactor 42 as densely as possible, as shown in drawing 5 . Since carbon content fuel gas and oxygen content gas pass along an independent gas passageway and are mixed in a fission reactor 42 within the burner 40 for manufacture of fullerene by this, there are no worries about a backfire etc. Furthermore, since the burner 40 for manufacture of fullerene is divided separately, manufacture is easy and repair is possible by exchanging only the burner 40 for manufacture of fullerene which broke down also when it was failure further. With the gestalt of this operation, although the cooling jacket section 47 was formed

in burner 40 the very thing for manufacture of fullerene, the cooling jacket section cannot be prepared in the burner for manufacture of fullerene, but the cooling section can also be prepared in a bottom plate, and the burner for manufacture of fullerene can be arranged to a bottom plate still more densely by this.
[0016] Next, the burner 56 for manufacture of the fullerene concerning the gestalt of the 4th operation shown in drawing 8 is explained. The burner 56 for manufacture of these fullerene is used instead of the burner 40 for manufacture of the fullerene concerning the gestalt of the 3rd operation, and is put in order and used for a bottom plate 43. And the fundamental configuration of the burner 56 for manufacture of fullerene is the same as that of the burner 27 for manufacture of the fullerene concerning the gestalt of the 2nd operation. that is, it is shown in drawing 8 -- as -- the burner 56 for manufacture of fullerene -- the lower part (namely, upstream) of a burner head 57 -- the 1st and 2nd accumulator 58 and 59 -- having -- an accumulator 58 -- either carbon content fuel gas or oxygen content gas -- an accumulator 59 -- either carbon content fuel gas or oxygen content gas -- it has the feed hoppers 60 and 61 into which another side is introduced. The large insertion hole 62 of a path and the small insertion hole 63 of a path are formed in a burner head 57, and the pipe 64 is inserted in the large insertion hole 62 of a path. The bore of a pipe 64 serves as a bore of the insertion hole 63, an EQC, or an approximate value (for example, 0.5-3mm). The diaphragm 65 which classifies the 1st and 2nd accumulator 58 and 59 serves as sealing structure, and the perimeter of the pipe 64 to penetrate is sealed by welding or solder attachment.

[0017] Comparatively large jet nozzle 65a of a path is prepared in the center of a burner head 57, and two or more nozzle stomata 66 are formed in it at the point section. From this jet nozzle 65a, it is possible to put in other matter (for example, silicon, metals, other inorganic substance powder, activity, or inert gas) except carbon content fuel gas and oxygen content gas in a fission reactor, and the conjugated compound of fullerene can be manufactured if needed. Moreover, when special, carbon content fuel gas and oxygen content gas can also be blown [******] into a fission reactor. Even if it is this case, since the premix of the gas blown is not carried out, a backfire etc. does not happen, it is stabilized and operation can do it. With the gestalt of this operation, although not considered as cooling structure, the burner-head body is possible also for circulating a refrigerant, further, can prepare the cooling jacket section or a cooling pipe in a bottom plate 43, and can also be cooled to it. By using the burners 40 and 56 for manufacture of the 3rd and the fullerene concerning the gestalt of the 4th operation, each burner can be changed an individual exception and the manufacturing installation of more large-sized fullerene can be constituted. By preparing a mounting flange in the perimeter of the burners 40 and 56 for manufacture of the 3rd and the fullerene concerning the gestalt of the 4th operation, it demounts to a bottom plate 43 simply, and becomes possible. Refractories can also be suitably stuck on the part which has not exposed the burners 40 and 56 for manufacture of fullerene on the front face of a bottom plate 43.
[0018] This invention is not limited to the gestalt of operation of said each, and this invention is applied also when it constitutes the manufacturing installation of fullerene combining the gestalt of said operation. Moreover, in the gestalt of said operation, there are aromatic hydrocarbon, such mixture, etc., such as alt.** meta besides the aliphatic series saturation which can use the thing of arbitration as carbon content fuel gas, for example, has a straight chain or branched chain, such as methane, ethane, a propane, ethylene, and a propylene, or unsaturated hydrocarbon, the above mentioned benzene, and toluene, a xylene of Para, naphthalene, and an anthracene. Since the temperature in a fullerene composition region is low temperature as compared with other approaches, construction of large-sized equipment of the combustion method with which the above mentioned burner for manufacture of fullerene is used is attained, and it is fit for mass production method of fullerene. Although the approach of generally carrying out the incomplete combustion of the above-mentioned carbon hydrogen raw material using the gas which makes oxygen (oxygen gas and ozone gas) a subject although the conditions of arbitration may be set up will be used if the combustion methods and conditions in a combustion method are conditions which fullerene generates, the mixed gas (oxygen content gas) of inert gas, such as helium and an argon, and oxygen may be used for this oxygen. Although the combustion temperature in this case is based also on the class of coal-for-coke-making-ized hydrogen, it

is usually about 1200-1700 degrees C more preferably 1000-2100 degrees C. Moreover, although what is necessary is just to also choose suitably the rate of the carbon content fuel gas and oxygen content gas in combustion, it becomes smaller oxygen content capacity to stoichiometric combustion oxygen content capacity. Moreover, although the pressure in a fission reactor is arbitrary if it is a pressure which can manufacture fullerene, generally it is good that it is 30 - 100torr more preferably ten to 600 torr. In addition, in the gestalt of said the operation of each, although the burner for manufacture of hula lanes was formed in the pars basilaris ossis occipitalis of a fission reactor, the fitting location and approach are arbitrary.

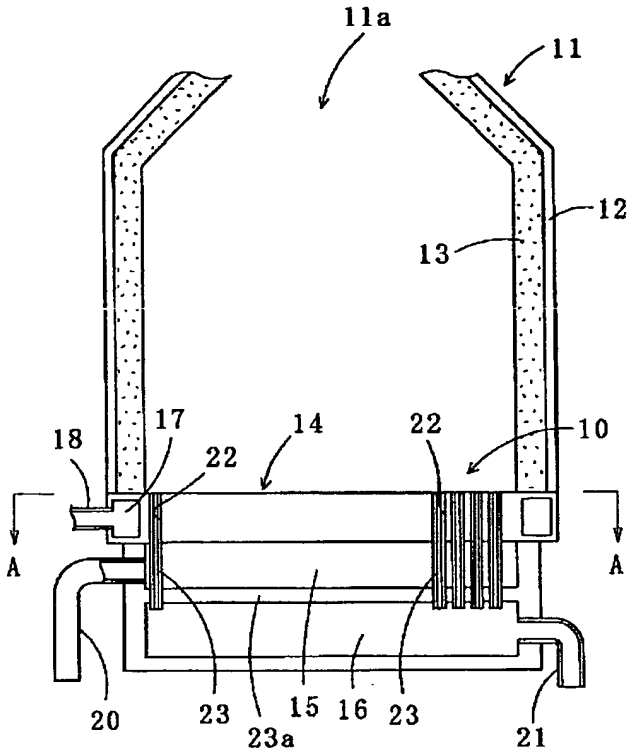
[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view of the manufacturing installation which uses the burner for manufacture of the fullerene concerning the gestalt of operation of the 1st of this invention.
[Drawing 2] A view A-A sectional view [in / in (A) / drawing 1] and (B) are the explanatory views of the modification of an exhaust nozzle part.
[Drawing 3] It is the sectional view of a manufacturing installation using the burner for manufacture of the fullerene concerning the gestalt of operation of the 2nd of this invention.
[Drawing 4] It is a view B-B sectional view in drawing 3 .
[Drawing 5] It is the sectional view of a manufacturing installation using the burner for manufacture of the fullerene concerning the gestalt of operation of the 3rd of this invention.
[Drawing 6] It is the detail sectional view of the burner for manufacture of the said fullerene.
[Drawing 7] It is this top view.
[Drawing 8] It is the sectional view of the burner for manufacture of the fullerene concerning the gestalt of operation of the 4th of this invention.
[Description of Notations]
The burner for manufacture of fullerene, 11:manufacturing installation, 11a, 11b : 10: A fission reactor, 12 : A furnace wall, 13:refractory material, 14:burner head, 15, 16:accumulator, 17: 20 The cooling jacket section, 18:inlet port, 19:outlet, 21 : A feed hopper, 22: 24 An insertion hole, 23:pipe, a 23a:diaphragm, 25 : An exhaust nozzle, 26 : A pipe, the burner for manufacture of 27:fullerene, a 27a:manufacturing installation, 28 : A burner head, 29, 30:accumulator, 31, 32:feed hopper, 37 33, 34:insertion hole, 35:pipe, 36:diaphragm, 38 : An exhaust nozzle, 40: The burner for manufacture of fullerene, 41:manufacturing installation, 42 : A fission reactor, 43 : A bottom plate, 44:burner head, 45, 46:accumulator, 47:cooling jacket section, 48 : An inlet port, 49:outlet, 50:insertion hole, 51:square pipe steel, 52:diaphragm, 53, 54:feed hopper, the burner for manufacture of 56:fullerene, 57:burner head, 58, 59:accumulator, 60, 61:feed hopper, 62, 63:insertion hole, 64:pipe, 65:diaphragm, a 65a:jet nozzle, 66: Nozzle stoma

[Translation done.]

Drawing selection Representative drawing



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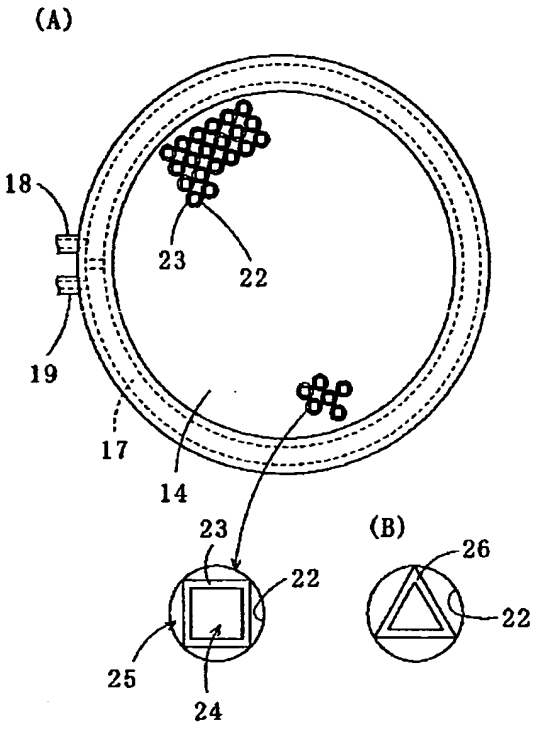

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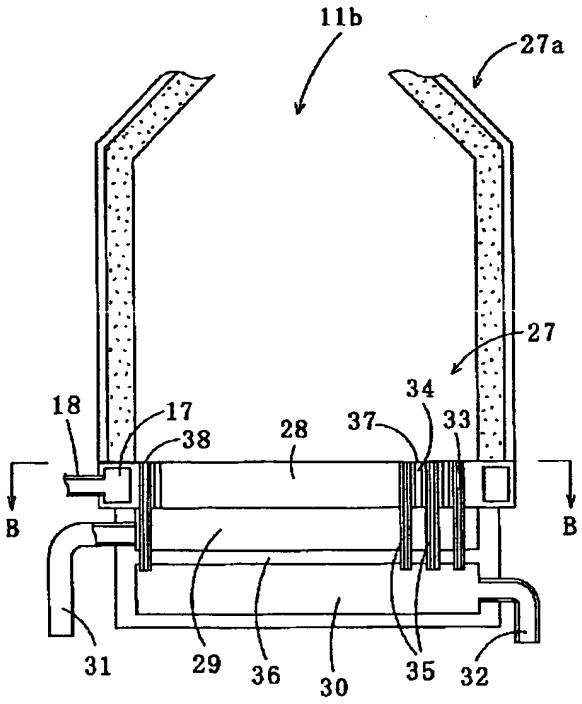

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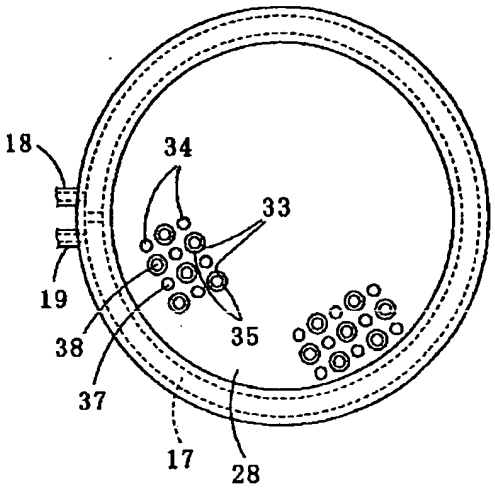

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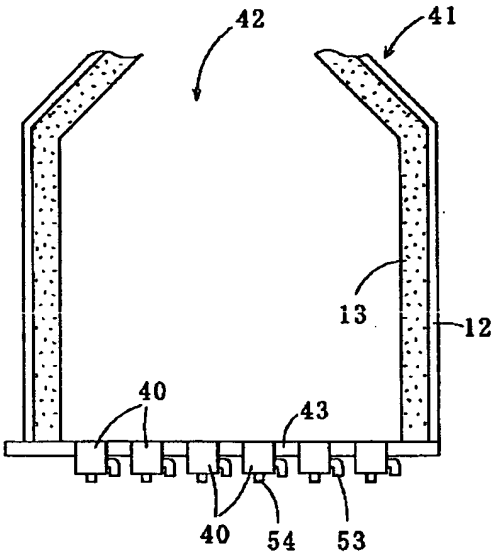

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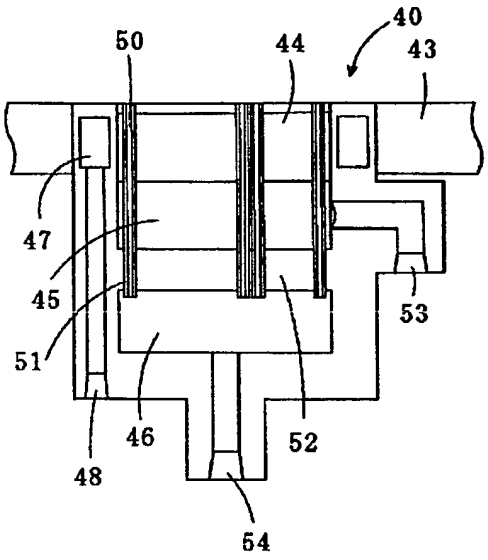
Drawing selection drawing 6



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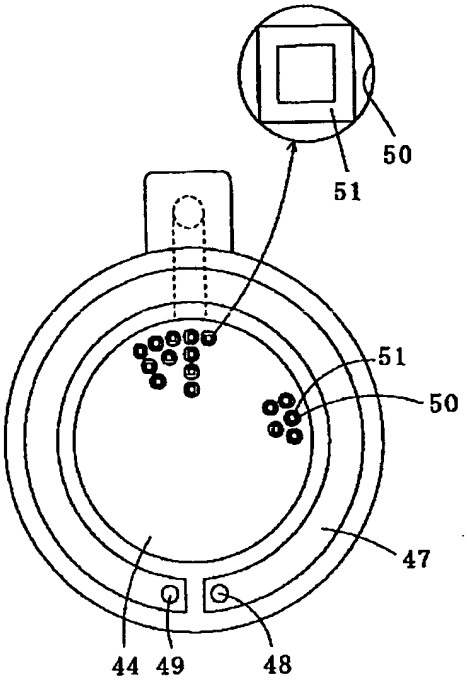

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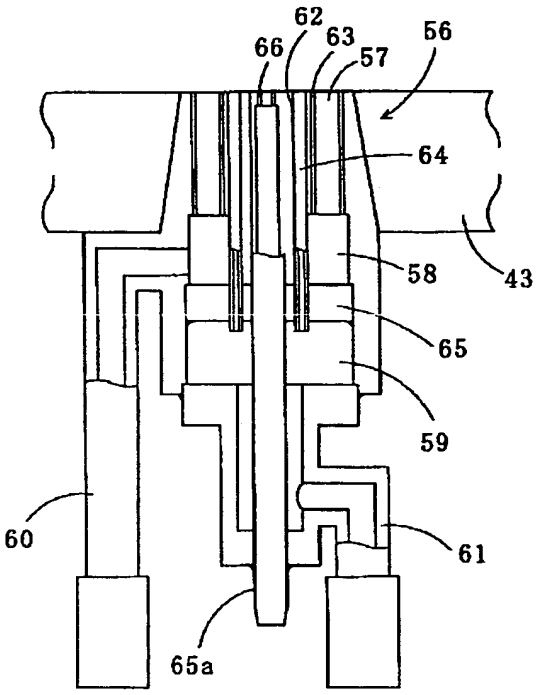

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